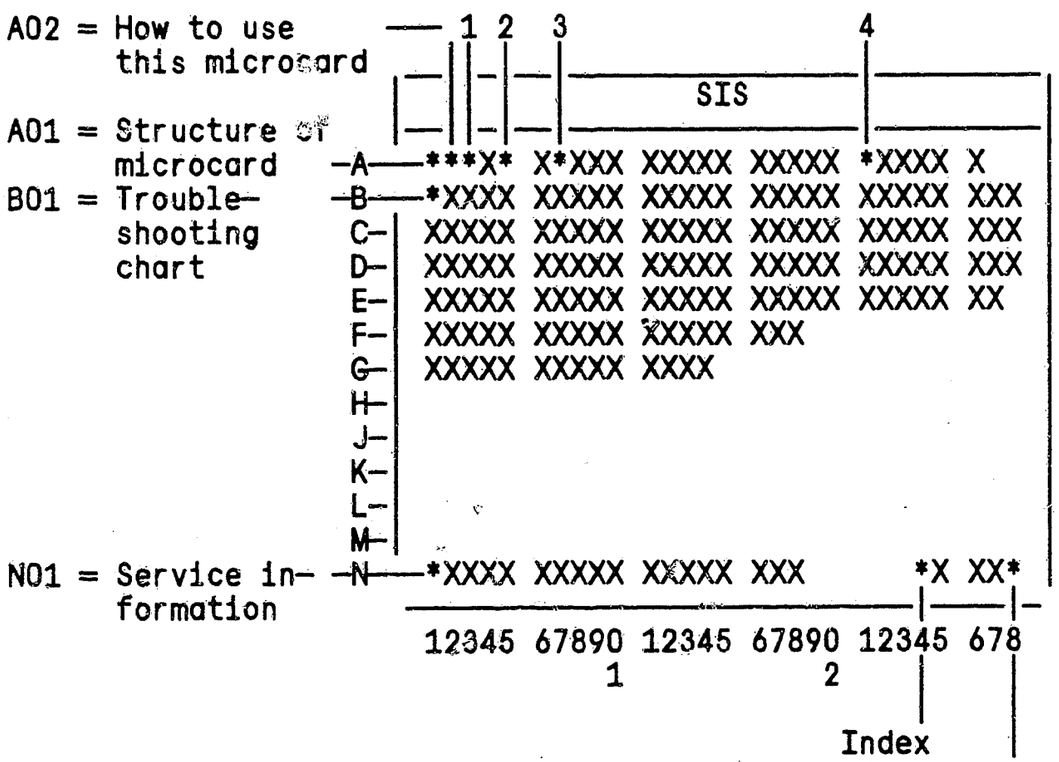
STRUCTURE OF THIS MICROCARD (BASIC INSTRUCTIONS)

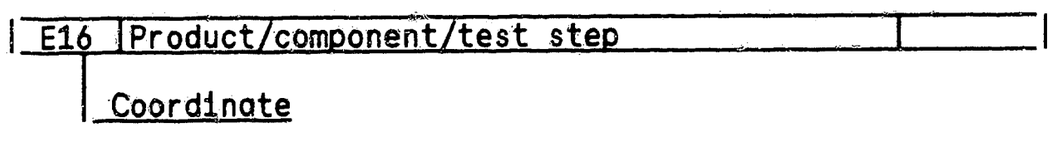


N28 = Table of contents and publication information

1 = Special features
2 = Safety and precautionary measures
3 = Testers and tools
4 = Installation position of components

a. Read from left to right.

b. Title of micropicture (appears on each micropicture).



c. Limits of section

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Beginning	Mid-section	End	One-page section

HOW TO USE THE MICROCARD

Trouble-shooting instructions for

System: MOTRONIC ML 4.1

Descriptions, photographs, terminal designations and special features refer to vehicle:

* OPEL Omega
  2,0 l / 4 Zyl. 10.86->

These basic instructions are comprehensive trouble-shooting instructions. They must not be used as vehicle-specific instructions. Caution! Descriptions and photographs may deviate from the vehicle-specific brief instructions.

Mandatory set values, terminal assignments and special features should be taken from the vehicle-specific brief instructions only. For brief instructions, see table of contents Microcard KFZ-00..

SPECIAL FEATURES

* Motronic system ML 4.1 with self-diagnosis and flashing-code output.

* Fault lamp (engine indicator lamp) in instrument panel.

* One common sensor for engine speed and reference mark.

* Single-winding rotary actuator

* Lambda closed-loop control

* Tank-ventilation valve

* Variant encoding for adaptation to different octane numbers, vehicles with or without catalytic converter and also to the type of transmission.

Fault lamp (engine indicator lamp).

The instrument panel contains a fault lamp which comes on after the ignition has been switched on. It goes out after the engine has been started. If the fault lamp comes on while the engine is running, this indicates a fault in the Motronic. The fault lamp is also used for outputting the flashing code of stored faults.

Variant encoding for Motronic ML 4.1:

To be able to adapt the engines to different fuel qualities, to operation with or without catalytic converter and also to different versions of transmission, appropriate encoding is provided via the Motronic wiring harness.

The object of encoding is to reduce the number of models of control unit. Several ignition maps, lambda maps and other maps are programmed into one control-unit model. The desired maps are addressed by encoding.

Map adaptation is accomplished via different control-unit terminals. These are the terminals 10, 15, 27 and 28.

For map adaptation to the octane number, an encoding plug is installed on the Motronic wiring harness. With the encoding plug, terminal 15 is connected via various resistors to the vehicle ground. The encoding plug already contains the necessary circuitry. Map adaptation is accomplished by changing the plug round. The current RON number is the one facing the closing bracket.

Fuel with too low an octane number causes knocking. Before filling up with such fuel, empty the tank as far as possible. After tanking, set the encoding plug to the required octane number. Fuel with a higher octane number may be used.

The terminal 27 can be used to set either regulated operation with a catalytic converter or unregulated operation without catalytic converter for leaded fuel.

In the event of operation with a catalytic converter, the lambda-sensor plug must be connected to the plug of terminal 27. Terminal 27 is thus connected to ground via the lead of the sensor heater.

Adaptation to the type of transmission (manual transmission or automatic transmission) is effected by way of the terminals 10 and 28.

Different wiring harnesses are supplied as standard for manual transmissions and automatic transmissions.

The terminal 10 can therefore be permanently wired in the control-unit plug.

Terminal 28 is connected to ground in the case of manual transmission, whereas it is either open or closed with automatic transmissions depending on the driving position.

Terminal 28 is connected to ground by way of the selector lever in positions P and N.

Terminal 28 is open (infinity Ω) in all other selector-lever positions.

If a driving position is engaged, the idle speed is reduced as a function of temperature if necessary, so as to prevent driving-off.

Fuel-evaporation monitoring system/ tank-ventilation valve

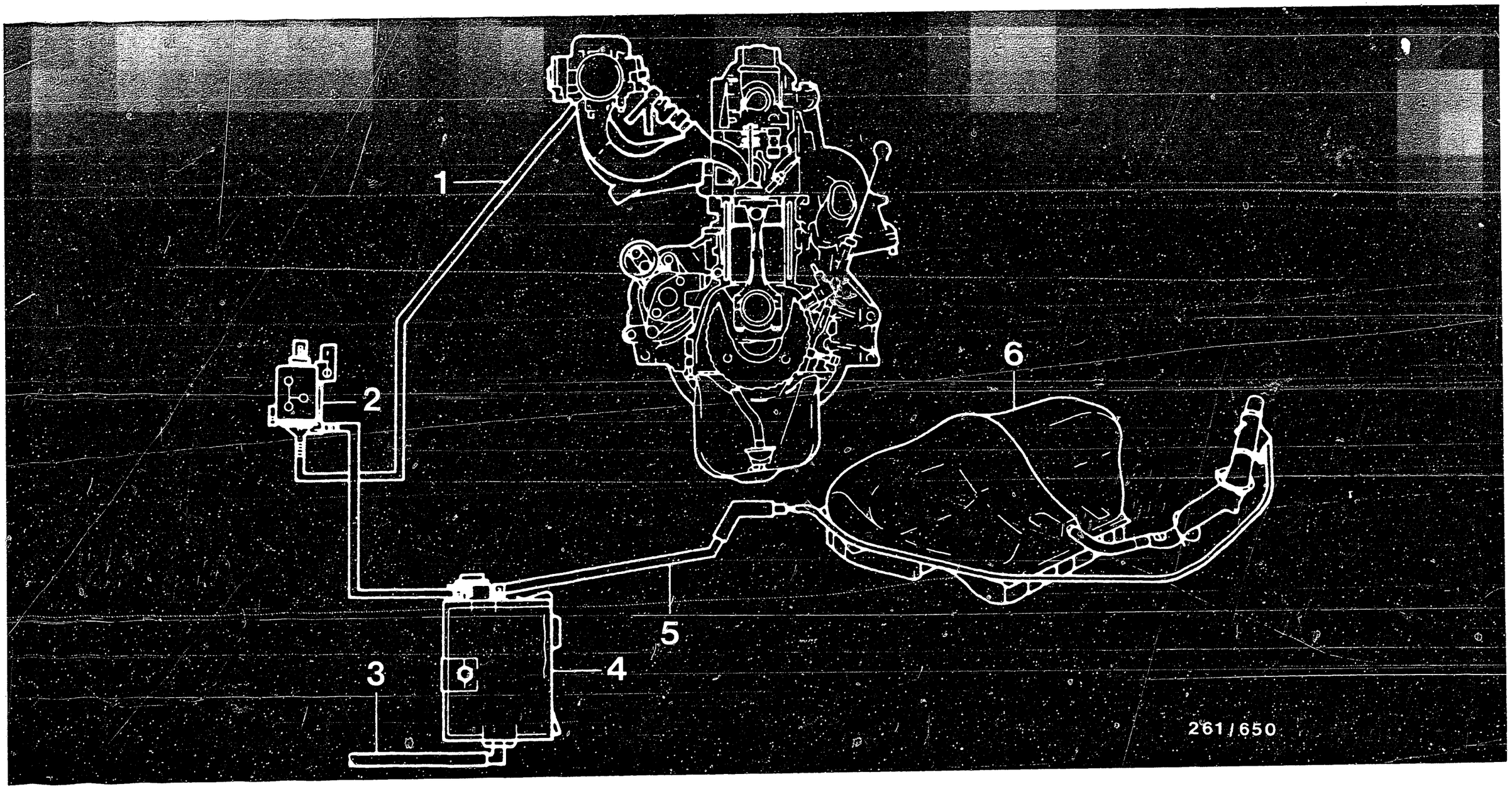
The purpose of the tank-ventilation valve is to supply the fuel vapors stored in the active-carbon container to the combustion chamber after starting.

The fuel vapors released are led through the tank-ventilation line to the active-carbon container. Here, the fuel vapors are absorbed by the active-carbon fill.

Depending on the operating state of the engine, the electromagnetically operated tank-ventilation valve is energized by the Motronic control unit and opens the purge line to the engine.

With the ignition off and with the engine idling with the idle contact closed, the tank-ventilation valve closes the purge line. At part load above the programmed operating point, the tank-ventilation valve opens.

The carbon fill is cleaned by a ventilation line on the base of the active-carbon container.



Fuel-evaporation monitoring system with tank-ventilation valve.

1 = Purge line
2 = Tank-ventilation valve
3 = Ventilation line
4 = Active-carbon container
5 = Tank vent
6 = Fuel tank

SAFETY AND PRECAUTIONARY MEASURES

Be sure to observe safety and precautionary measures so as to avoid risk to persons and to prevent damage to the engine, trigger boxes, control units or the ignition system.

CAUTION!
High-energy ignition system with dangerous high and low voltages!

Touching live parts or terminals may be highly dangerous (both on the primary and secondary sides).

For testing the compression, disconnect pump relay in order to prevent undesired injecting of the injection valves.

Do not short-circuit ignition coil term. 1 to ground (e.g. for switching off the engine).
Ignition coil and possibly control unit will be destroyed.

Never connect positive pole of battery to ignition coil term.1. Control unit will be destroyed.

If installing an alarm system, follow the installation instructions for Motronic vehicles (refer to microcard "Overview of After-Sales Service Information KFZ-00..")

Make sure that the alarm relay is not disturbed by external fields (e.g. by ignition cables), causing it to trigger incorrectly.

SAFETY AND PRECAUTIONARY MEASURES
(CONTINUED)

Never start engine without battery securely connected (battery terminals tightened).
Do not disconnect battery from vehicle electrical system with engine running.

Do not use a fast charger for starting the engine.
Provide starting assistance only with second 12 V battery and jump leads.
Caution! Owing to non-standardized requirements of vehicle manufacturers with regard to electronic products, we advise against using a 24 V battery for starting assistance.

When charging the battery in the vehicle or providing starting assistance, follow the operating instructions for the fast charger as well as instructions of the vehicle manufacturer.

Disconnect battery from vehicle electrical system before charging or fast-charging.

Incorrect polarity of the supply voltage, e.g. through incorrect connection of the battery or ignition coil, may lead to the destruction of a control unit.

Do not connect or disconnect wiring-harness plugs from control units or trigger boxes with the ignition on.

Remove control units at temperatures above + 80° C (paint-drying installation).

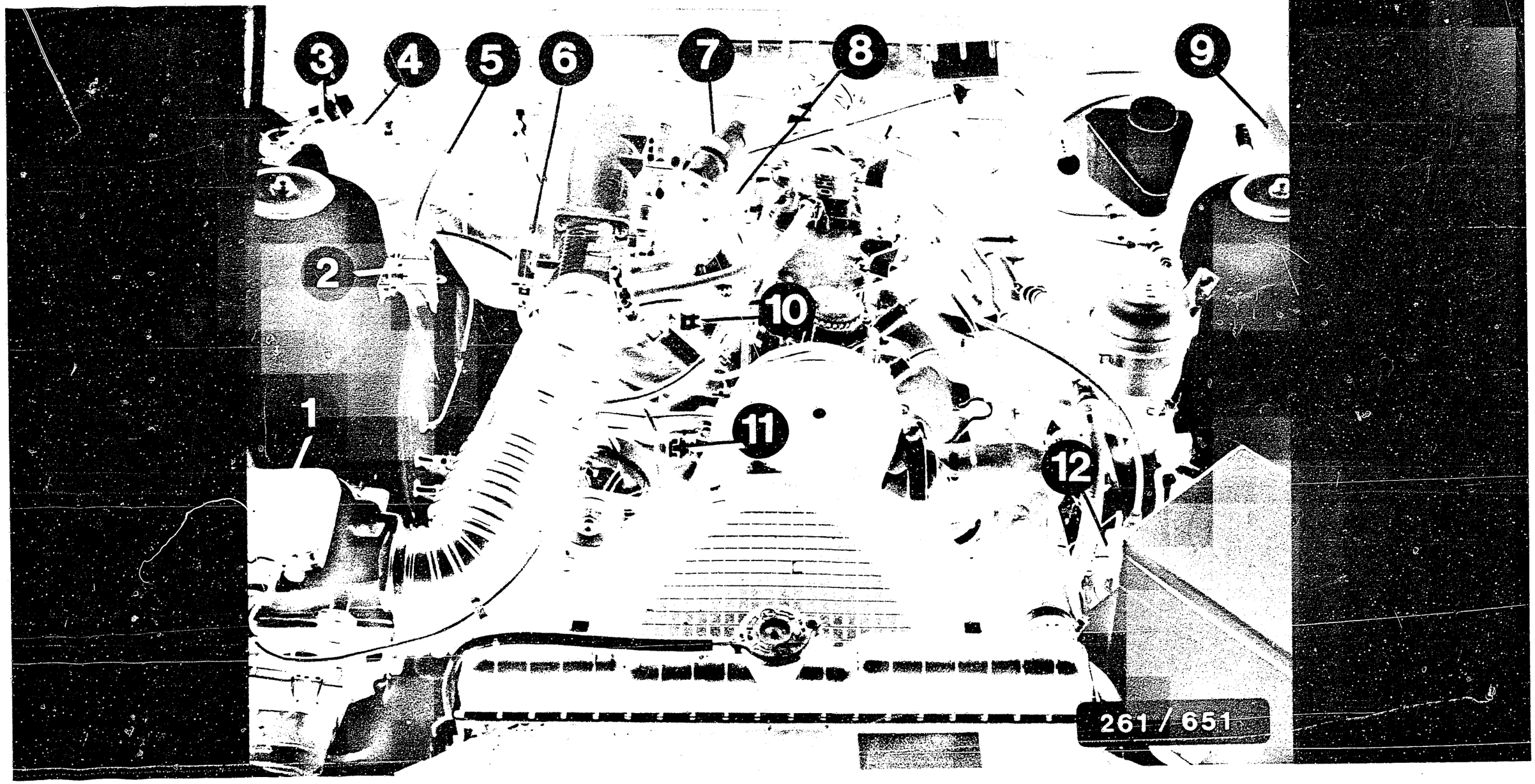
Remove control units before carrying out electric welding work.

TEST EQUIPMENT AND TOOLS

Description	Designation	Part no.
Motortester	e.g. MOT 201 MOT 300 MOT 400	0 684 000 201 0 684 000 300 0 684 000 400
Diagnostic cable for spark-advance angle measurement		1 687 224 633
Exhaust-gas analyzer	e.g. ETT 008.02 or ETT 008.03	0 684 100 802 0 684 100 803
Multimeter (internal resistance min. 20 k Ω /V)		Commercially available e.g. Metrawatt GmbH Type MA2H or Fluke Multimeter 75 or 23
Pressure gauge 6 bar or Pressure tester or Pressure tester (no longer available) Three-way line as connecting part for KDJE-P 100 and KDEP 1034	Quality class 1.0 0.1 bar graduations	687 231 154 KDJE-P 100 KDEP 1034 KDJE-P 100/13

TEST EQUIPMENT AND TOOLS (continued)

Description	Part no.
Feeler gauge for measuring sensor air gaps (up to 1 mm)	Commercially available
Lubricant for engine-speed and reference-mark sensor	Molykote Longterm 2, commercially available
Chassis dynamometer e.g. LPS 96 or LPS 002	0 680 017 001 0 680 100 200
Test lead 2-pole, for measuring resistances and signals e.g. at injection valves	1 684 463 093
Test leads for correct connection of testers at component plugs	KDZS 0004 (2.8 mm wide) KDZS 0005 (6.3 mm wide)
Mounting paste VS 14016 Ft for Lambda sensor and exhaust-gas screw plug	5 964 080 112
Hose clamper for pinching off fuel and air hoses	Commercially available



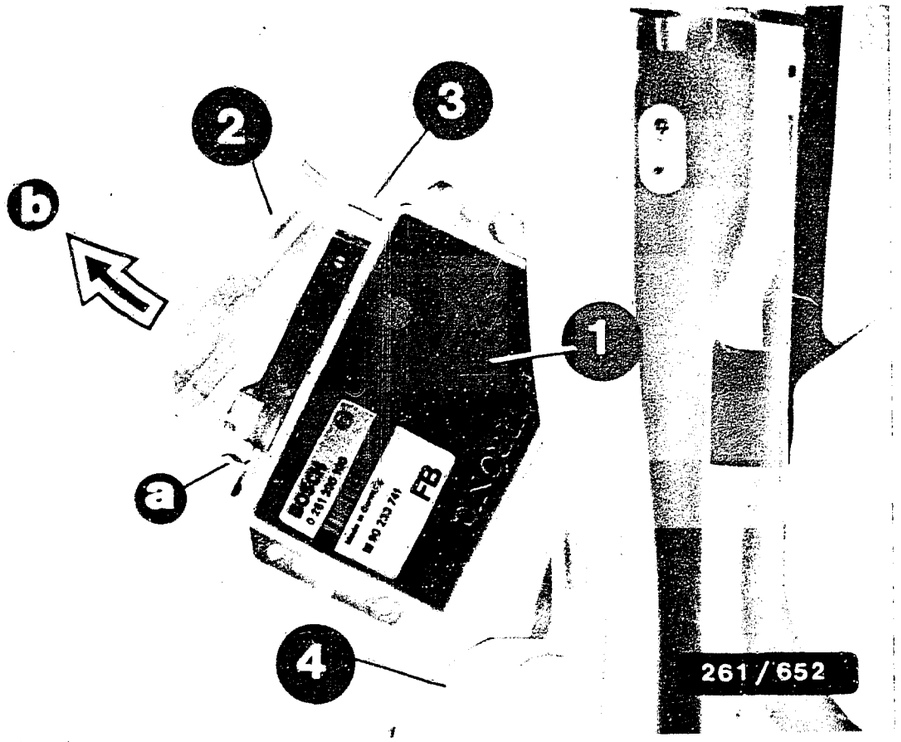
INSTALLATION POSITION OF COMPONENTS

1 = Air-flow sensor
2 = Tank-ventilation valve
3 = Octane-number encoding plug
4 = Active-carbon filter
5 = Diagnostic plug
6 = Throttle-valve switch

A13 —— ⟹

7 = Idle actuator
8 = Pressure regulator
9 = Motronic relay
10 = Injection valves
11 = Temperature sensor (engine)
12 = Ignition coil

A14 —— ⟺



1 = Control unit
2 = Plug
3 = Mechanical encoding with locking lug
4 = Cover over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The indications "left" and "right" refer always to the forward direction of travel.

* Control unit:
  In front-passenger footwell on right-hand side. Slightly raise rubber strip and cover on door sill. Fold carpet to side and remove control-unit cover. Unscrew control unit. Unlock plug (a), hinge (arrow b) and unhook (Item 3).

* Temperature sensor (engine):
  In engine block below mounting of alternator.

Arrow = Reference-mark/engine-speed sensor

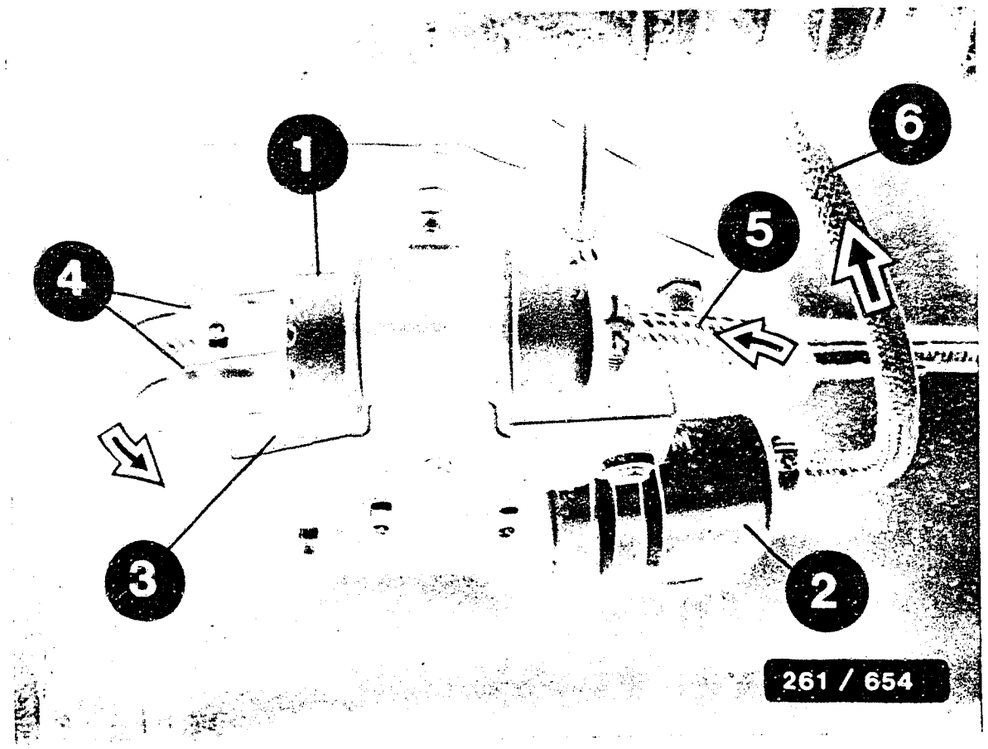
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Reference-mark/engine-speed sensor:
  In engine block, left, behind V-belt pulley beneath fastening flange.

* Lambda sensor:
  In common exhaust pipe before catalytic converter.

* Fuses:
  In instrument panel at bottom left. Fuse box can be hinged out on its lower side.

* Temperature sensor (air):
  In air-flow sensor



1 = Electric fuel pump
2 = Fuel filter
3 = Pressure damper

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Electric fuel pump and fuel filter:
  In front of fuel tank.

* Ground terminals:
  On engine block at front right, under screw cover for engine oil.

* Diagnostic plug:
  In engine compartment on right on firewall.

* Octane-number encoding plug:
  In engine compartment on right on firewall.

A17 — <==

For production reasons:
continued on the following coordinate.

A18 — => <=

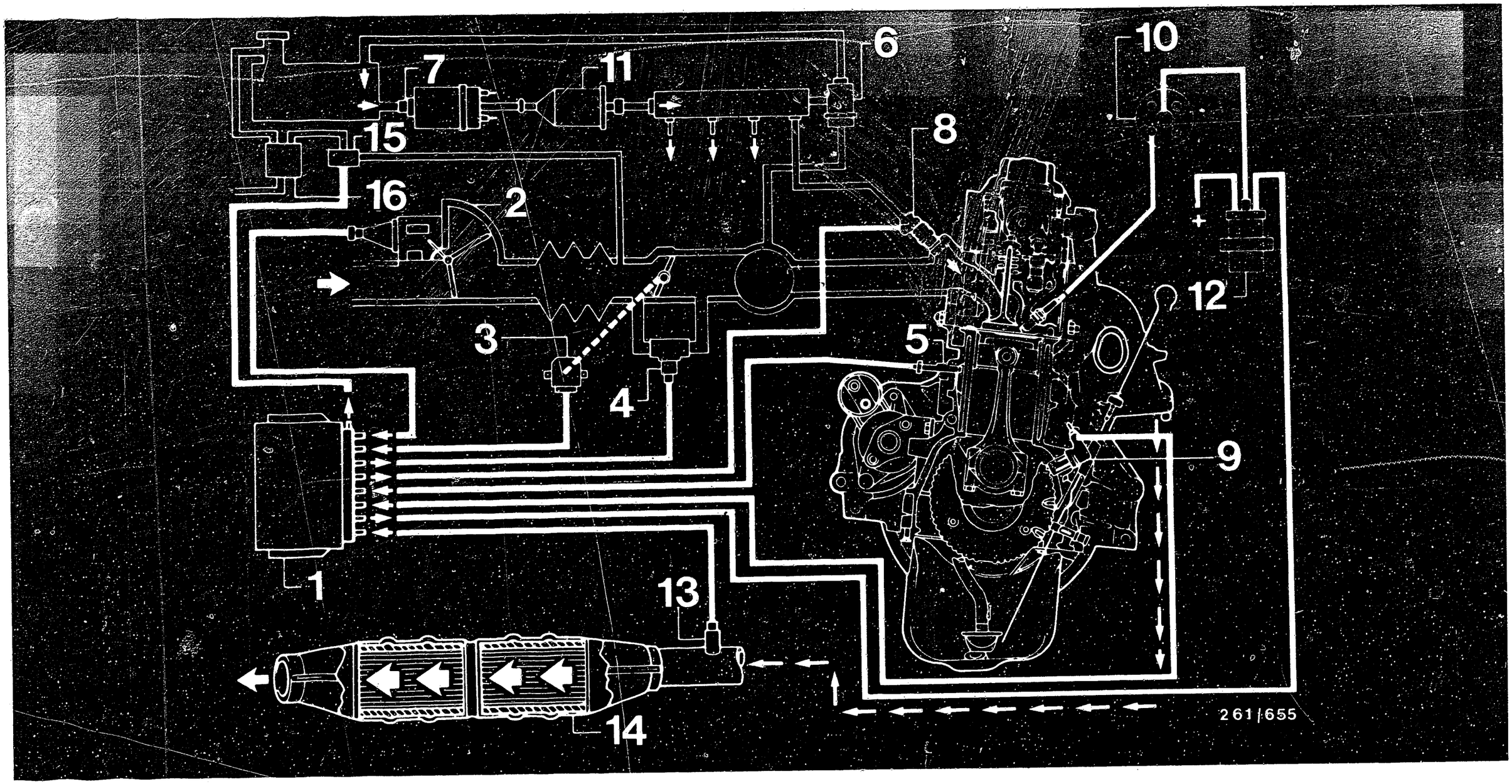


DIAGRAM OF AIR/FUEL LINES (SYSTEM OVERVIEW)

1 = Motronic control unit
2 = Air-flow sensor
3 = Throttle-valve switch
4 = Single-winding rotary actuator
5 = Temperature sensor (engine)
6 = Pressure regulator
7 = Fuel pump
8 = Injection valve
9 = Engine-speed/reference-mark sensor
10 = High-voltage distributor
11 = Fuel filter
12 = Ignition coil
13 = Lambda sensor
14 = Catalytic converter
15 = Motronic relay
16 = Tank-ventilation valve

HOW TO USE TROUBLE-SHOOTING CHART AND TROUBLE-SHOOTING PROGRAM

The TROUBLE-SHOOTING CHART starts with Coordinate B03 and contains customer complaint (fault symptom/fault characteristic feature) together with several possible causes in each case (component faults) and coordinate information for detailed trouble-shooting. If no coordinates are given, this is because the causes concerned do not require any test instructions.

In the event of a clearly established customer complaint, proceed consecutively and step by step as indicated in the trouble-shooting instructions in the stated sequence of possible causes.

Trouble-shooting should always be commenced with self-diagnosis (if provided) or with the universal test adapter (if possible). Only then should trouble-shooting be continued in line with the trouble-shooting chart.

In the event of a customer complaint which is not clear-cut, all causes indicated in the trouble-shooting chart must be tested. In order to avoid incorrect measurements, all causes are to be checked in the specified sequence (on account of the interdependence of test steps).

If the cause of the customer complaint has still not been eliminated after testing all possible faults, fit new prescribed ignition coil and/or trigger box/control unit.

HOW TO USE TROUBLE-SHOOTING CHART AND TROUBLE-SHOOTING PROGRAM (CONTINUED)

The TROUBLE-SHOOTING PROGRAM contains all system and component tests indicated in the trouble-shooting chart. It is sub-divided into three rows of boxes.

The left-hand column contains test instructions and set values.
The center column contains information on trouble-shooting and fault elimination.
The right-hand column contains pictures/connection diagrams linked to the text together with explanatory notes.

If the questions posed in the left-hand column can definitely be answered with "yes", trouble-shooting is to be continued with the next box below.

If the answer to the question is "no", the center column must be applied and the tests performed in the sequence indicated there.
Following fault elimination, repeat test as a check.

TEST PREREQUISITES:

- Battery fully charged
- Engine in proper mechanical working order (e.g. compression, valve clearance etc.)
- Engine at operating temperature of approx. +80°C (if necessary)
- Proper connection of all connectors of wiring harness

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Enging knocking/pinging.
10. Engine overheating.
11. Fault lamp.

1	2	3	4	5	6	7	8	9	10	11	Cause (component defect)	Coord.
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis	B07
*											Voltage at control unit	D01
*											Sensors	D05
*		*			*	*					Fuel pressure	D15
*		*				*	*				Solenoid-operated injection valves	D21
		*	*								Idle contact	E13
					*						Full-load contact	E17
	*	*	*	*	*	*					Air-flow sensor	E05
	*	*	*								Idle actuator	E25
*	*	*	*								Air-intake system	E19
		*									Idle speed	F07
*		*		*	*						Ignition coil	E23
*		*	*	*	*						Primary signal	F01
		*	*	*	*	*					Secondary pattern	F03
*	*	*	*		*	*		*	*		Ignition timing	F05
		*									Exhaust gas	F09
		*									Overrun cutoff	F11
		*	*	*							Interference-suppression resistors	F03
		*	*	*							Noise test	E09
					*						Interference	D23

B03 — ⟹

TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine knocking/pinging.
10. Engine overheating.
11. Fault lamp.

1	2	3	4	5	6	7	8	9	10	11	Cause (component defect)	Coord.
				*							Throttle valve	—
				*							Fuel delivery	D19
	*	*	*								Tank vent	A06
		*	*								Lambda closed-loop control	B17
*	*	*	*	*	*	*		*	*	*	Control unit	—

B04 — ⟸

HOW TO USE SELF-DIAGNOSIS, SELF-DIAGNOSIS TEST TABLE AND TROUBLE-SHOOTING PROGRAM

This vehicle is equipped with a control unit which has a self-diagnosis feature. Therefore, start trouble-shooting with the self-diagnosis.

How to activate the self-diagnosis is described starting on Coordinate B07.
The self-diagnosis test table starting on Coordinate B11 contains:

- Fault indication (flashing code)
- Components or system functions under test
- Test instructions/test conditions
- Connection terminals
- Set-value specifications
- Coordinate references for trouble-shooting and fault rectification in the subsequent self-diagnosis trouble-shooting program.

B05 — ⟹

HOW TO USE SELF-DIAGNOSIS, SELF-DIAGNOSIS TEST TABLE AND SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (CONTINUED)

The self-diagnosis trouble-shooting program is split up into 3 columns as of Coordinate B17.

The left-hand column contains test instructions and set values.

The center column contains information on trouble-shooting and fault elimination.

The right-hand column contains pictures/terminal diagrams belonging to the text together with explanatory notes.

If the questions posed in the left-hand column can definitely be answered with "yes", trouble-shooting is to be continued with the next box below.

If the answer to the question is "no", the center column must be employed and the tests performed in the sequence indicated there.
If the self-diagnosis indicates a fault, but there is no system or component fault, the control unit is to be replaced.

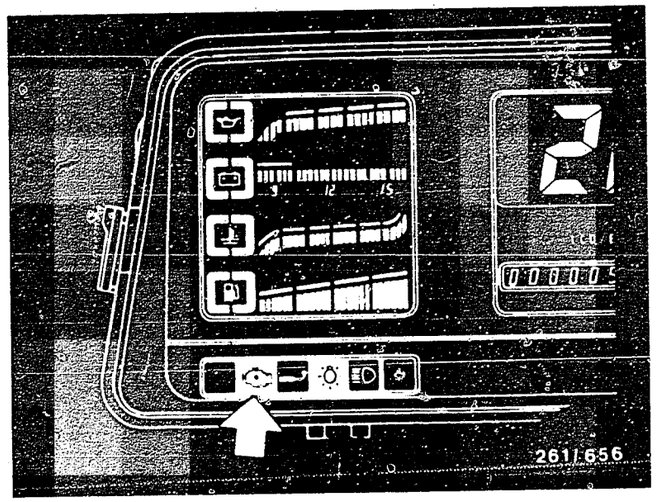
If no further system-specific faults are indicated by the self-diagnosis and the customer complaint (fault symptom) has still not been eliminated, trouble-shooting must be continued with the trouble-shooting chart as of Coordinate B03.

B06 — ⟸

SELF-DIAGNOSIS

Fault lamp (engine indicator lamp):

Fault lamp in instrument panel lights up after ignition has been switched on.
Start engine: 1. Fault lamp goes out soon after engine has started and if there is no fault present.
2. Fault lamp does not go out or comes on constantly or occasionally while driving:
evaluate flashing code.
Note: Faults which occur only briefly and lead to occasional lighting-up of the fault lamp are also stored.



Arrow = Fault lamp
(Engine indicator lamp)

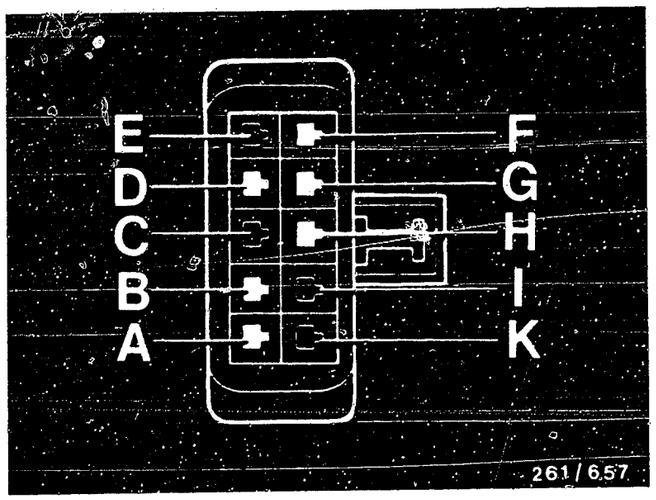
How to activate the self-diagnosis:

The diagnostic plug is in the engine compartment on the right-hand side (bottom picture).
Remove diagnosis protection plug. Using a wire, connect sockets A (ground) and B (stimulus lead to control unit term. 4) (bottom picture). Switch on ignition or let engine run. Fault lamp in instrument panel starts to flash.

Evaluating the flashing code:

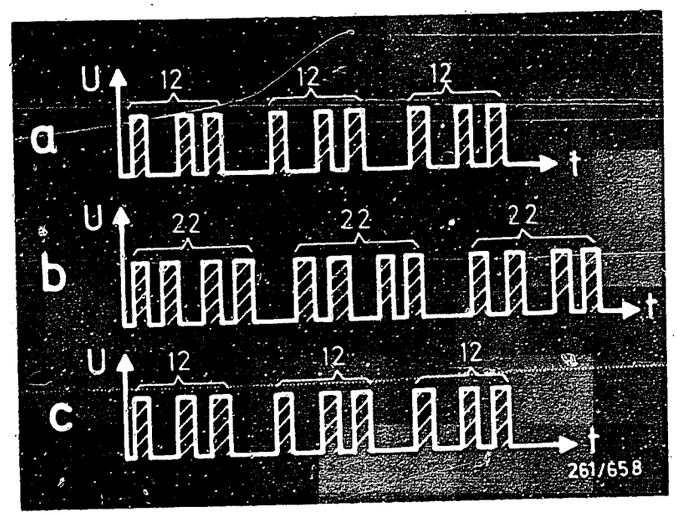
The flashing code for each fault consists of two blocks of flashing pulses. Each block represents a number and contains 1 to 9 pulses. One pulse corresponds to the number 1, 9 pulses correspond to the number 9. With each pulse, the fault lamp lights up briefly. Between the blocks there is a longer pause than between the individual pulses. Between two fault codes there is an even longer pause (approx. 3 seconds).
Each output of the diagnosis starts with the same initial code 1-2. This flashing code is repeated at least 3 times. It indicates that the diagnostic output is working. If there is no fault stored in the control unit, the flashing code 1-2 is repeated constantly.
If a fault is stored in the control unit, after the flashing code 1-2, the first fault is output 3 times. If a further fault is stored, its flashing code follows likewise 3 times. Up to max. 5 faults may be stored. After the last fault has been output, the flashing code starts again with 1-2, etc.

Top view of diagnostic plug



Diagnosis output is terminated by undoing the connection at the diagnostic plug or by switching off the ignition.

The fault memory in the control unit is erased if the battery or the control unit is disconnected for at least 10 seconds or if the ignition is switched on and off more than 20 times.



a = c = Flashing code 1 – 2
b = Fault code 2 – 2
Shaded pulse area =
Fault lamp lit

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Checking of component/function	Test instructions/Test conditions	Terminals	Set values	Coordinate
1 2	Control unit/flashing-code output O.K.	Flashing-code output not working if fault lamp, leads to fault lamp and to diagnostic plug as well as power supply to control unit are defective. If everything O.K., but no flashing code is output, control unit is defective.	4, 17	———	
1 3	Lambda sensor/voltage change	Open circuit in lead to lambda sensor. Sensor heating defective. Sensor clogged.	24	———	B17
1 4	Temperature sensor (engine)/short circuit to ground	Check temperature sensor and lead for short circuit to ground.	13	———	B21
1 5	Temperature sensor (engine)/open circuit	Check temperature sensor and leads for open circuit. Temperature-sensor resistance: at +15...+30°C : at approx. +80°C	13, ground	 See brief inst. See brief inst.	B23
4 4	Lambda sensor/short circuit to ground	Check lead for short circuit to ground. Watch for worn cable insulation.	24	———	B17
4 5	Lambda sensor/short circuit to battery voltage	Check lead for short circuit to battery voltage. Watch for worn cable insulation.	24	———	B17
4 8	Supply voltage to control unit too low (with engine running)	Supply voltage: Check voltage drops at positive and negative terminals. Charge battery.	35(+), 5(-)	See brief inst.	B25
4 9	Supply voltage to control unit too high (with engine running)	Supply voltage: Check regulator.	35(+), 5(-)	See brief inst.	B27

B11 — ⟹

B12 — ⟺

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Checking of component/function	Test instructions/Test conditions	Terminals	Set values	Coordinate
5 1	Control unit/digital part	Control unit defective	——	———	C01
6 5	Idle potentiometer for CO adjustment/voltage too low	Measure resistance of potentiometer. Check lead for short circuit to ground. Open circuit at term. 9. Term. 6 and term. 9 jumped.	30	See brief inst.	C03
6 6	Idle potentiometer for CO adjustment/voltage too high	Measure resistance of potentiometer. Check potentiometer and leads for open circuit and short circuit to battery voltage. If open circuit at term. 6, fault code 7 4 will also occur.	30	See brief inst.	C05
6 7	Throttle-valve switch/ idle contact	Fault: idle contact permanently closed. Idle contact closed in rest position: Open throttle valve slightly:	2,ground	0 Ω Infinity Ω	C09
6 9	Temperature sensor (air)/short circuit to ground	Check temperature sensor and lead for short circuit to ground.	22	———	C13
7 1	Temperature sensor (air)/open circuit	Check temperature sensor and leads for open circuit. Temperature-sensor resistance: at +15°C...+30°C:	22,6(-)	See brief inst.	C13
7 2	Throttle-valve switch/ full-load contact	Fault: full-load contact permanently closed. Fault lamp comes on only occasionally on overrun. Full-load contact closed in full-load position: Ease off accelerator slightly:	3	0 Ω Infinity Ω	C17

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Checking of component/function	Test instructions/Test conditions	Terminals	Set values	Coordinate
7 3	Air-flow sensor/short circuit to ground	Check lead to term. 7 for open circuit to ground. Open circuit in lead to term. 7 and term. 9 or term. 6 and term. 9 jumped.	6,7,9	———	C21
7 4	Air-flow sensor/open circuit	Check lead to term. 6 for open circuit. (Fault code 6 6 also appears). Check leads to term. 6 and term. 7 for short circuit to positive (5 or battery positive). Check resistances of air-flow sensor: : between term. 6 and term. 7 (deflect sensor flap): between term. 6 and term. 9:	6(-), 7	 See brief inst. See brief inst.	C25
7 5	Transmission switch/ short circuit to ground	Fault: switch permanently closed. Check lead for short circuit to ground.	8	———	—

SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (1)

V

SELF-DIAGNOSIS
FLASHING CODE 13 / 44 / 45

N>

Repair defective lead/plug.

Lambda sensor malfunctioning.

* Flashing code 13:
Using ohmmeter, check lead from control unit term. 24 to lambda sensor for open circuit.
Check plug for corrosion and loose contact.
Contacts must not allow themselves to be pushed back.
Check sensor heating.

* Flashing code 44:
Using ohmmeter, check lead from control unit term. 24 to lambda sensor for short circuit (contact) to ground.
Watch for worn insulation and loose contact.

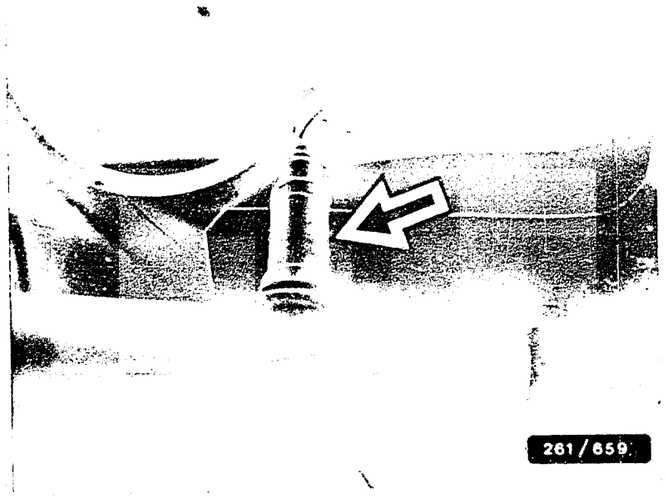
* Flashing code 45:
Lead from control unit term. 24 to lambda sensor has connection to live lead (short circuit to battery voltage due to insulation damage). Watch for worn insulation and loose contact.

Leads and plugs O.K.?

Y

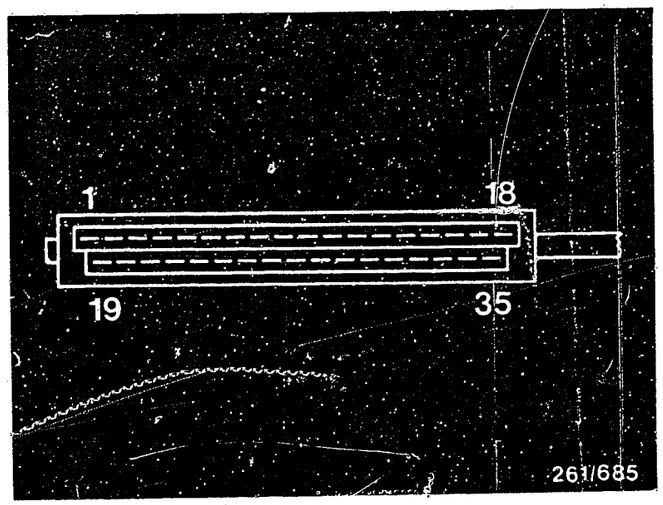
V

Continued on next picture page



Arrow = Lambda sensor

Top view of 35-pin control-unit plug of Motronic wiring harness



SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (1) CONTINUED (1)

V

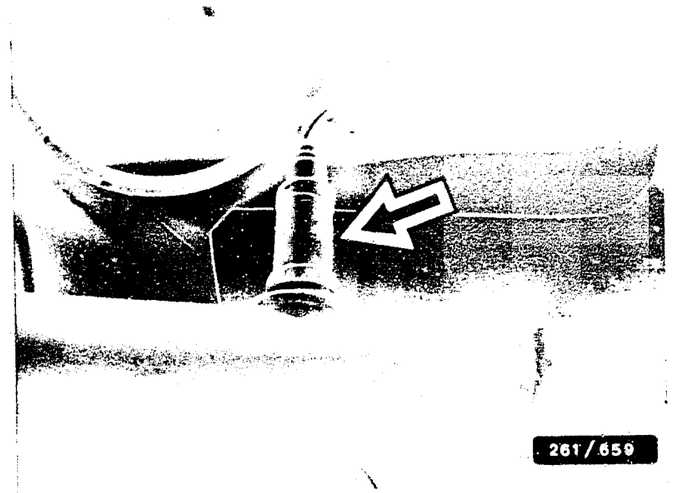
Replace lambda sensor. Flashing code now O.K.? 13 / 44 / 45 — N> — Replace control unit

Y

V

Return to self-diagnosis test table B11

B19 — <⟹>



Arrow = Lambda sensor

B20 — <⟹>

SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (2)

V

SELF-DIAGNOSIS
FLASHING CODE 14 / 15

N> Replace air-flow sensor.

Test coolant-temperature sensor (engine):

Disconnect plug from temperature sensor.
Test resistance directly at plug pins of temperature sensor:

Set value:
see brief instructions

Is set value reached?

Y

V

Perform visual examination on plug of temperature sensor:

N> Eliminate defects on plug. If necessary, replace plug or spring contacts.

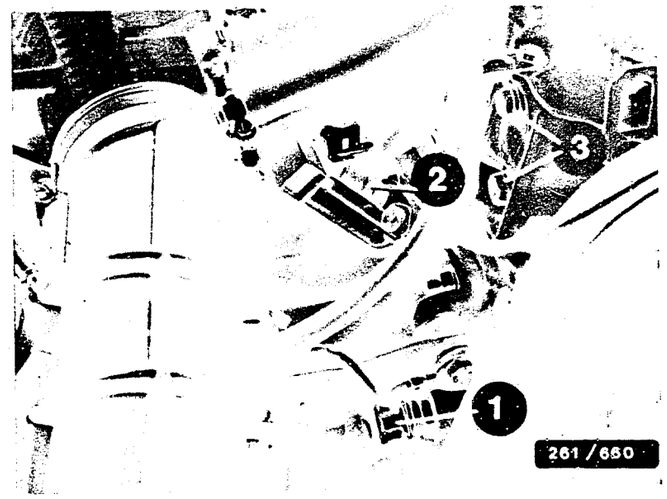
Plug correctly connected, contacts corroded? Spring contacts must be latched and must not allow themselves to be pushed back.

Plug O.K.?

Y

V

Continued on next picture page



1 = Temperature sensor (engine)
2 = Injection valve
3 = Ground terminals

SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (2) CONTINUED (1)

Using ohmmeter, check leads to temperature sensor for open circuit and short circuit. From temperature-sensor plug to control-unit plug term. 13 and to vehicle ground.

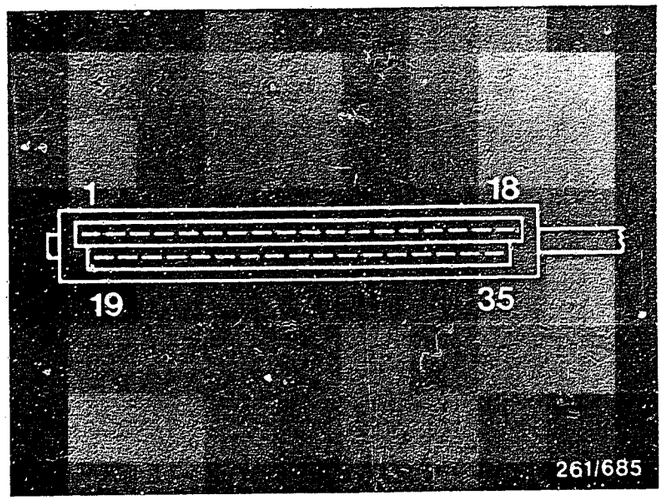
Leads O.K.?

NO → Eliminate contact resistances, open circuits or short circuits on leads.

YES ↓

Return to self-diagnosis test table B11

B23 — ⟺



Top view of 35-pin control-unit plug of Motronic wiring harness

B24 — ⟺

SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (3)

V

SELF-DIAGNOSIS
FLASHING CODE 48

N> Eliminate defects at terminals. If necessary, replace plug-in connections. Replace main relay.

Fault:
Supply voltage at control unit term. 35 less than 10 V with engine running.

Check voltage drops (contact resistances) at ground terminal and positive lead.
Terminals and plug-in connections must be bare down to the metal and free from corrosion.
Positive terminals concerned:
on relay term. 87 and term. 30 as well as on ignition lock term. 15.

Try replacing relay.

Voltage drops eliminated?
Relay O.K.?

Y

V

Check state of charge of battery.

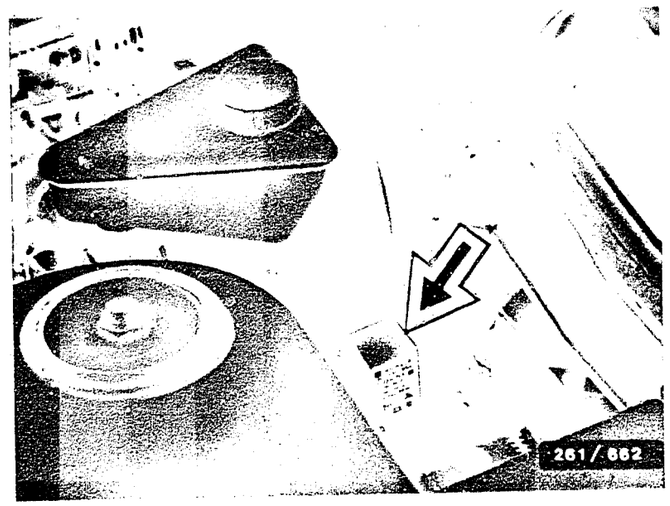
Battery sufficiently charged?

N> Charge battery.

Y

V

Return to self-diagnosis test table B11



Arrow = Motronic relay

B25 — <⟹>

B26 — <⟹>

SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (4)

V

SELF-DIAGNOSIS
FLASHING CODE 49

N>

Replace regulator.

Fault:
Supply voltage at control unit term. 35 greater than 16 V with engine running.

Check regulator.

Regulator O.K.?

Y

V

Return to self-diagnosis test table B11

B27 — <⟹>

B28 — <⟹>

SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (5)

V

SELF-DIAGNOSIS
FLASHING CODE 51

N> Replace control unit

The digital part in the control unit is tested.

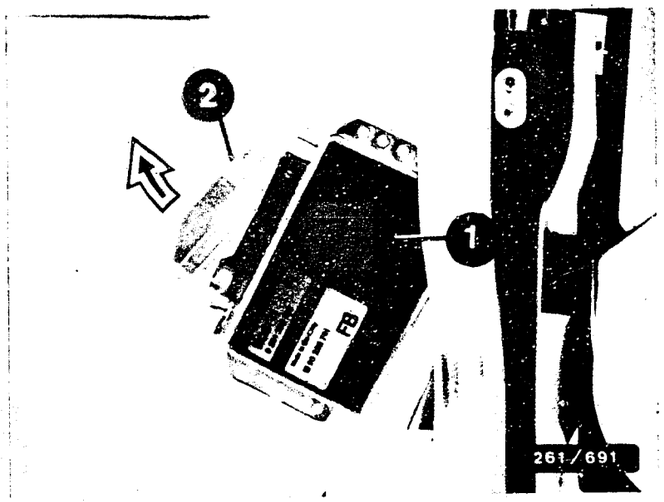
No flashing code?

Y

V

Return to self-diagnosis test table B11

C01 — <⟹>



1 = Control unit
2 = Plug
Arrow = Unlatch plug, raise in direction of arrow, then unhook

C02 — <⟹>

SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (6)

V

SELF-DIAGNOSIS
FLASHING CODE 65/66

N> Repair defective lead/plug.

Malfunction of idle potentiometer (in air-flow sensor) for CO adjustment.

Flashing code 65:
* Using ohmmeter, check lead from control unit term. 30 to air-flow sensor term. 1 for short circuit (contact) to ground. Watch for worn insulation and loose contact.

* Using ohmmeter, check lead from control unit term. 9 to air-flow sensor term. 3 for open circuit.
Check plug for corrosion and loose contact. Contacts must not allow themselves to be pushed back.

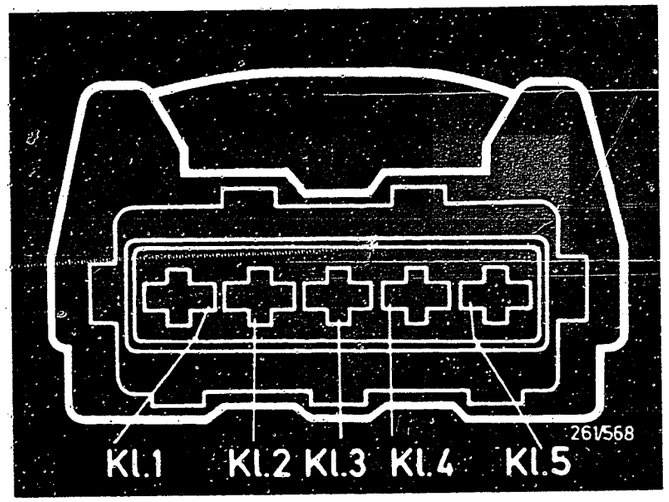
* Using ohmmeter, check leads from control unit term. 6 and term. 9 to air-flow sensor term. 4 and term. 3 for short circuit (contact) with one another.
Watch for worn insulation and loose contact.

Leads and plugs O.K.?

Y

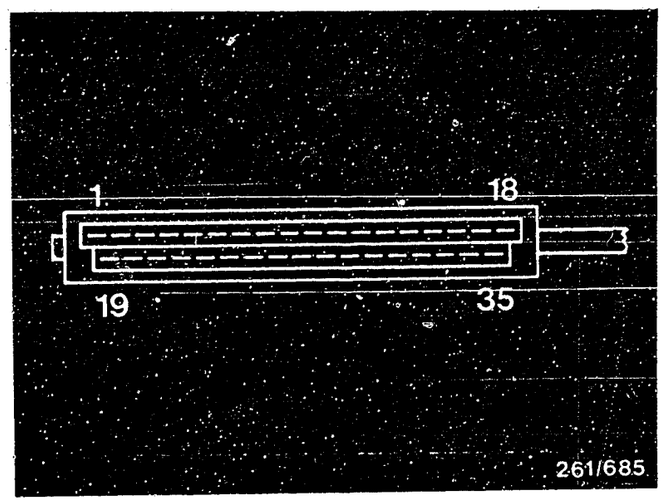
V

Continued on next picture page



Top view of plug for air-flow sensor

Top view of 35-pin control-unit plug of Motronic wiring harness



SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (6) CONTINUED (1)

V

SELF-DIAGNOSIS
FLASHING CODE 66

* Check leads from control unit term. 30 and term. 6 to air-flow sensor term. 1 and term. 4 for open circuit with ohmmeter. Check plug for corrosion and loose contact.
Contacts must not allow themselves to be pushed back.

* Check lead from control unit term. 30 to air-flow sensor term. 1 for short circuit (contact) with live lead: Disconnect plug from air-flow sensor. Switch on ignition. Connect voltmeter to term. 1 (+) and term. 4 (-) with test prods. If battery voltage present, look for defect in lead. Watch for worn insulation and loose contact. If not, air-flow sensor may also be defective (consequential damage).

Leads and plug O.K.?

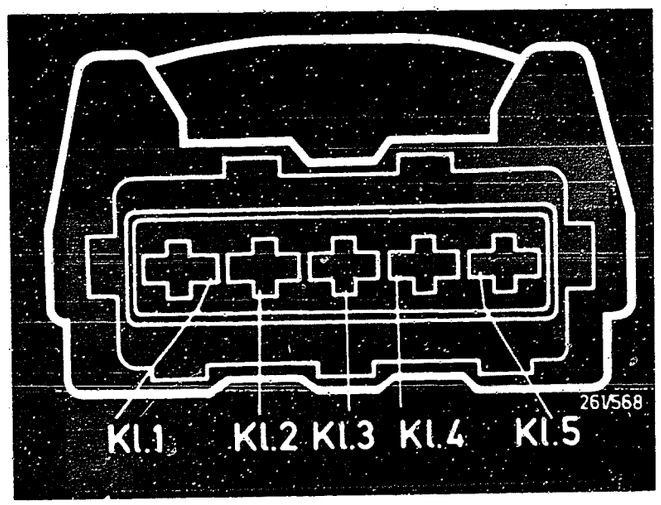
N>

Repair defective lead and/or defective plug.

J

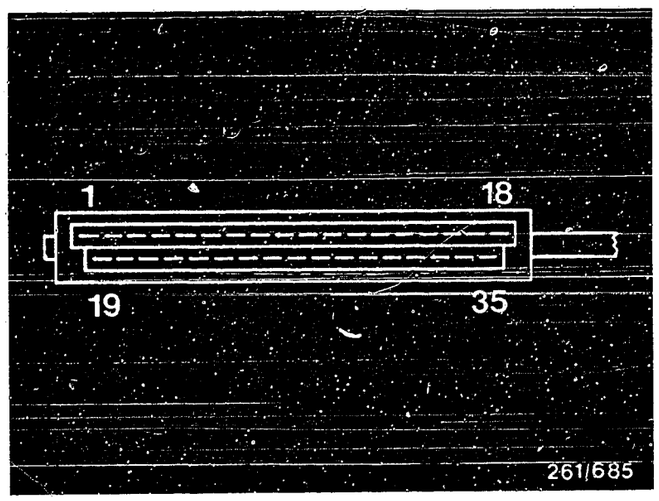
V

Continued on next picture page



Top view of plug for air-flow sensor

Top view of 35-pin control-unit plug of Motronic wiring harness



SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (6) CONTINUED (2)

V

SELF-DIAGNOSIS
FLASHING CODE 65 / 66

N>

Replace air-flow sensor.

Check idle potentiometer in air-flow sensor:

Disconnect plug from air-flow sensor.
Measure resistance values directly on air-flow sensor between
term. 1 and term. 4 as well as
term. 3 and term. 4:
SET VALUES:
see brief instructions

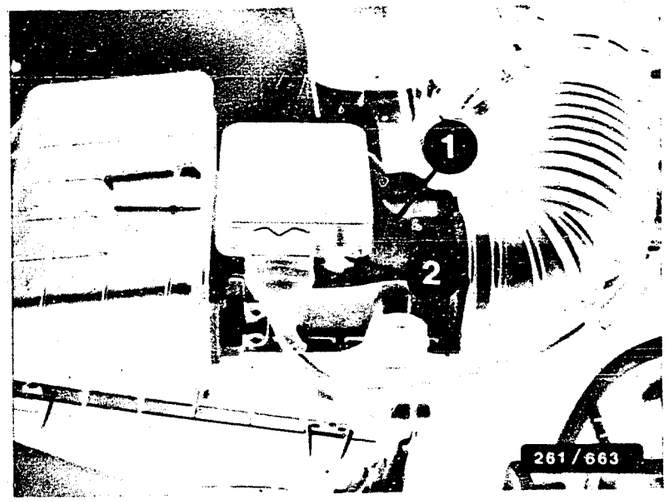
N o t e:
Remove cap over potentiometer-adjusting knob and turn potentiometer from stop to stop.
Do not leave adjusting knob at a stop, otherwise a fault will be indicated.
The center position is the basic setting. Turning the potentiometer clockwise means lengthening the duration of injection, turning counter-clockwise means shortening it.
Insert new cap.

Set values O.K.?

Y

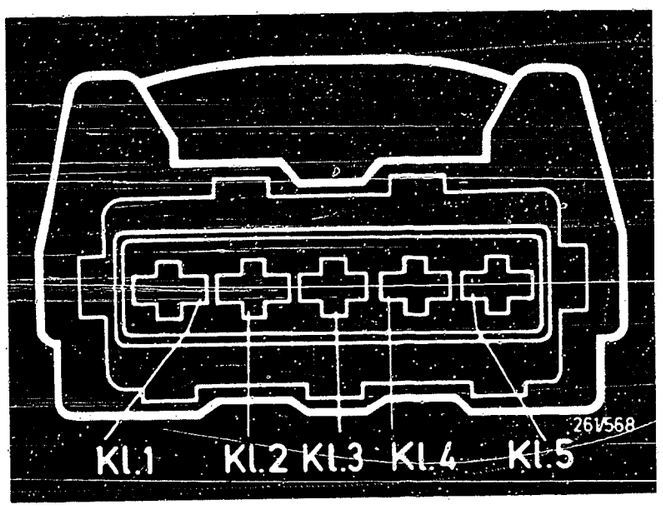
V

Return to self-diagnosis test table B11



1 = Air-flow sensor
2 = CO potentiometer

Top view of plug for air-flow sensor



SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (7)

SELF-DIAGNOSIS
FLASHING CODE 67

N>

Idle contact in throttle-valve switch remains permanently closed or does not open.

Check idle contact:
Disconnect plug from throttle-valve switch.
Throttle valve closed.
Connect ohmmeter to throttle-valve switch term. 2 and term. 18.
Set value: 0 Ω (continuity).
Open throttle valve:
Reading must change to infinity Ω after the throttle valve has been opened slightly.

Does resistance reading change from 0 Ω to infinity Ω ?

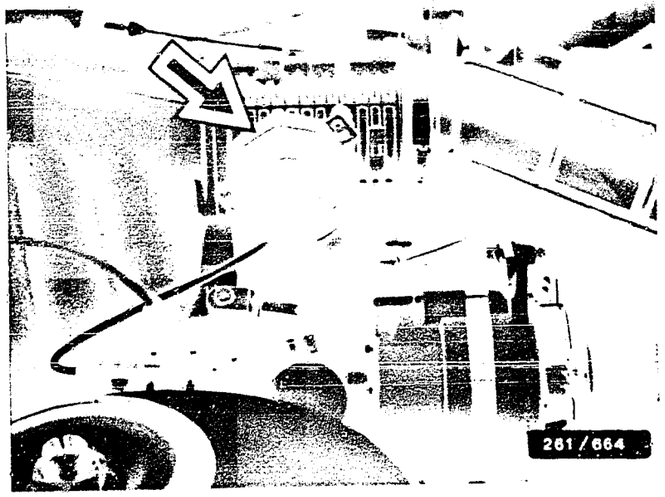
Continued on next picture page

* Resistance value remains at 0 Ω up to full-load stop (idle contact not opening):
Replace throttle-valve switch.

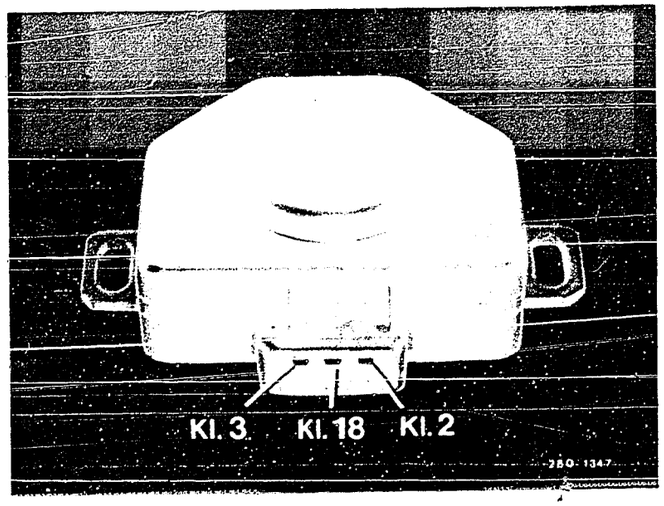
* Idle contact not closing (reading remains constant at infinity Ω) or idle contact opening too late:
Adjust throttle-valve switch.
* Requirements for throttle-valve switch adjustment:
+ Throttle valve correctly adjusted? It must come up against the stop screw with the lever just before it sticks. Lock screw against turning.
+ Adjust throttle cable/linkage free of tension.
If kinked -> replace.

Adjusting the throttle-valve switch:
Slightly loosen fastening screws. Connect ohmmeter to throttle-valve switch between term. 2 and term. 18. Turn throttle-valve switch until the idle contact closes (microswitch clicks audibly).
Reading 0 Ω . If not -> replace throttle-valve switch.

Continued on next picture page



Arrow = Throttle-valve switch



SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (7) CONTINUED (1)

V

Checking the adjustment:
Pull slightly on throttle cable. Idle contact must open (microswitch clicks audibly).

Reading: Infinity Ω

V

* Check leads to throttle-valve switch for contact with one another and with ground:
Disconnect plugs from control unit and throttle-valve switch. Connect ohmmeter, one after the other, to the plug of the throttle-valve switch between term. 2 and term. 18 as well as term. 2 and ground.

Set value:
Infinity Ω in each case.

Watch for worn insulation and loose contacts.

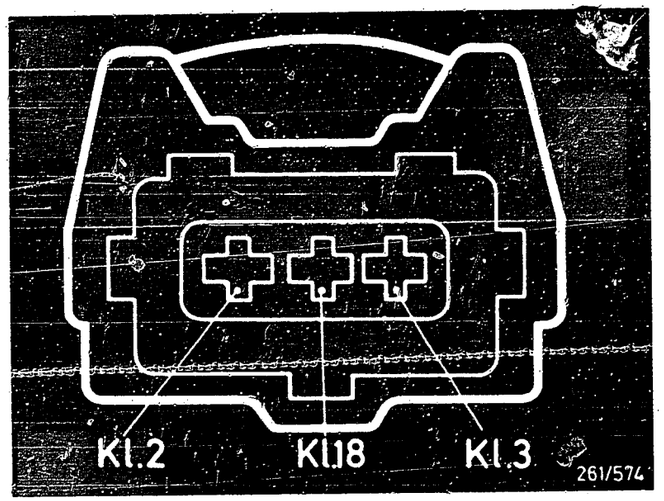
Set values obtained?

N> Eliminate short circuit on lead.

Y

V

Return to self-diagnosis test table B11



Throttle-valve switch plug

C11 — <⟹>

C12 — <⟹>

SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (8)

SELF-DIAGNOSIS
FLASHING CODE 69/71

Check temperature sensor (air) in air-flow sensor:

Disconnect plug from air-flow sensor.
Check resistance directly at air-flow sensor between term. 4 and term. 5:

Set value:
see brief instructions

Set value obtained?

N> Replace air-flow sensor.

Y

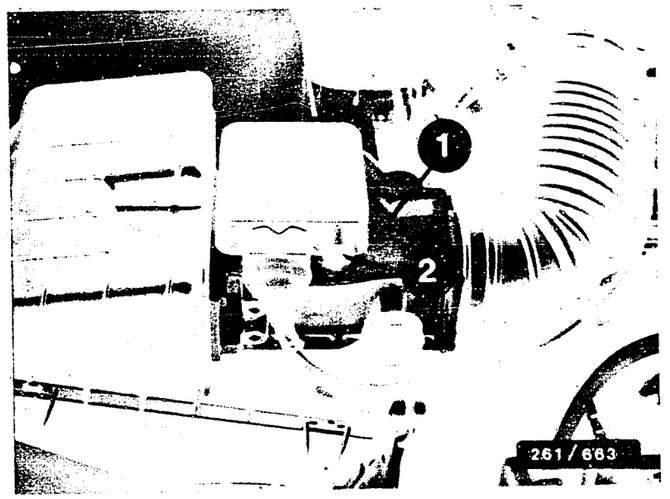
Perform visual examination on plug of air-flow sensor term. 4 and term. 5:
Plug correctly connected, contacts corroded? Spring contacts must be latched and must not allow themselves to be pushed back.

Plug O.K.?

N> Eliminate defects on plug. If necessary, replace plug or spring contacts.

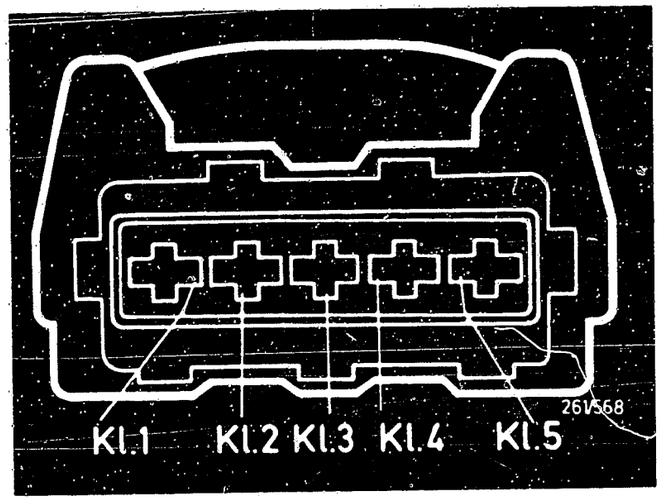
Y

Continued on next picture page



1 = Air-flow sensor
2 = CO potentiometer

Top view of plug for air-flow sensor



SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (8) CONTINUED (1)

V

Using ohmmeter, check leads to temperature sensor in air-flow sensor for open circuit and short circuit. From air-flow sensor plug term. 4 and term. 5 to control-unit plug term. 6 and term. 22

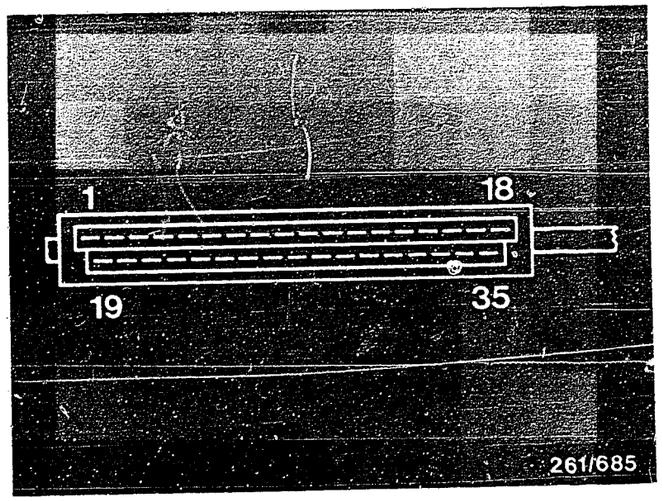
Leads O.K.?

N> Eliminate contact resistances, open circuits or short circuits on leads.

Y

V

Return to self-diagnosis test table B11



Top view of 35-pin control-unit plug of Motronic wiring harness

C15 — <⟹>

C16 — <⟹>

SELF-DIAGNOSIS
FLASHING CODE 72

Full-load contact in throttle-valve switch remaining permanently closed or not opening.

N o t e:
If there is a fault, the fault lamp comes on only occasionally on overrun. The fault is, however, permanently stored.

Check full-load contact:
Disconnect plug from throttle-valve switch.
Connect ohmmeter to throttle-valve switch term. 3 and term. 18.
Open throttle valve as far as it will go.

Set value:
Before the full-load stop, the reading changes from infinity Ω to 0 Ω .

Does reading change from infinity Ω to 0 Ω ?

N>

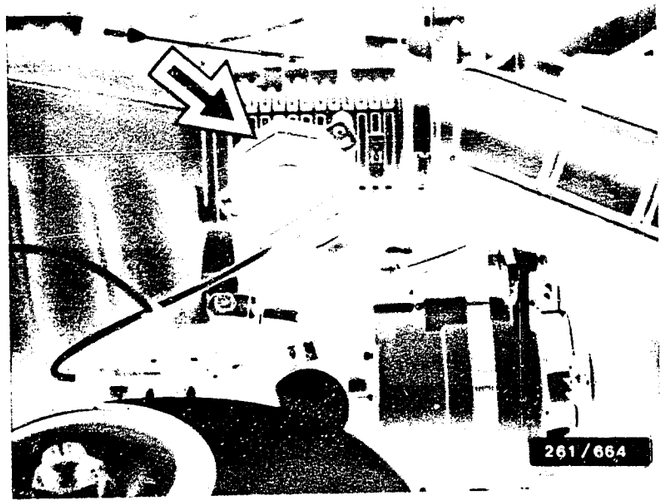
* Resistance value remains constantly on approx. 0 Ω (full-load contact does not open): Replace throttle-valve switch.

* Full-load contact does not close (reading remains constantly on infinity Ω): Check whether throttle valve is mechanically capable of opening fully.
If mechanical system is O.K., replace throttle-valve switch.

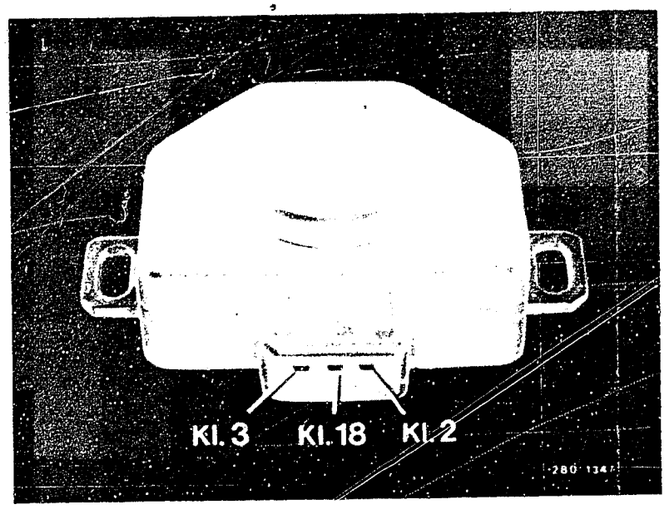
N o t e :
Full-load contact cannot be adjusted. If idle contact is correctly set, then the setting of the full-load contact is likewise correct.

Y

Return to self-diagnosis test table B11



Arrow = Throttle-valve switch



SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (10)

V

* Check leads to throttle-valve switch for contact with one another and with ground:
Disconnect plugs from control unit and throttle-valve switch.
Connect ohmmeter, one after the other, to the plug of the throttle-valve switch between term. 3 and term. 18 as well as term. 3 and ground.

Set value:
Infinity Ω in each case.

Watch for worn insulation and loose contacts.

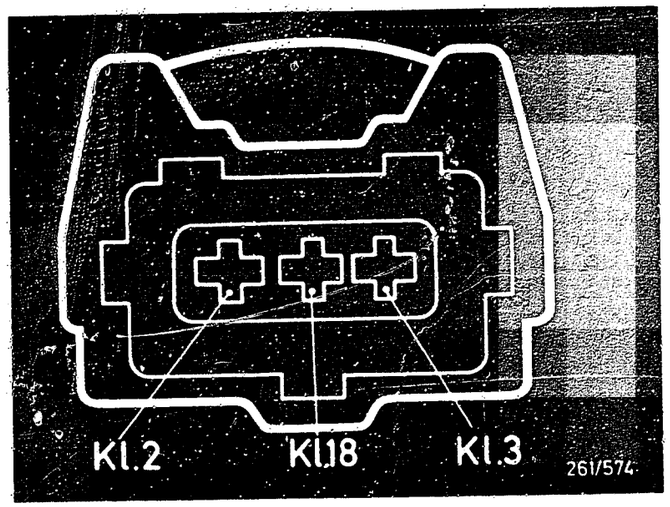
Set values obtained?

N> Eliminate short circuit on lead.

Y

V

Return to self-diagnosis test table B11



Throttle-valve switch plug

C19 — <⟹>

C20 — <⟹>

SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (11)

V

SELF-DIAGNOSIS
FLASHING CODE 73/74

N> Replace air-flow sensor

Check air-flow sensor with ohmmeter:

Disconnect plug from air-flow sensor.

Measure resistance values directly at the plug pins of the air-flow sensor:

For set values between term. 4 and term. 3 as well as between term. 4 and term. 2 see brief instructions.

Set values obtained?

Y

V

Visually inspect plug of air-flow sensor:

N> Eliminate defects on plug. If necessary, replace plug or spring contacts.

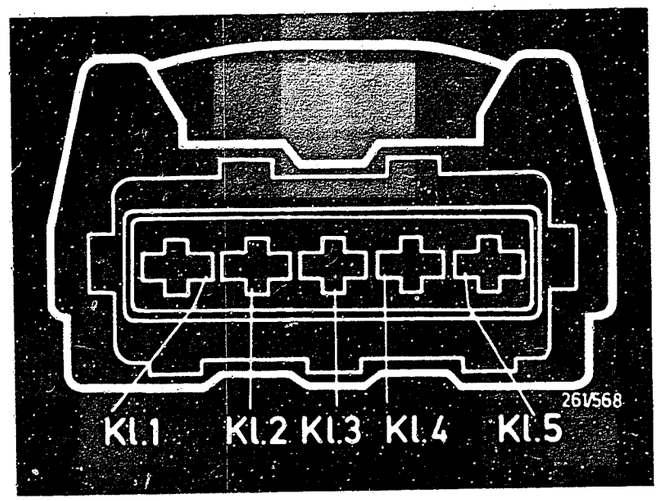
Plug properly attached, contacts corroded? Spring contacts must be engaged and it must not be possible to push them back.

Is plug O.K.?

Y

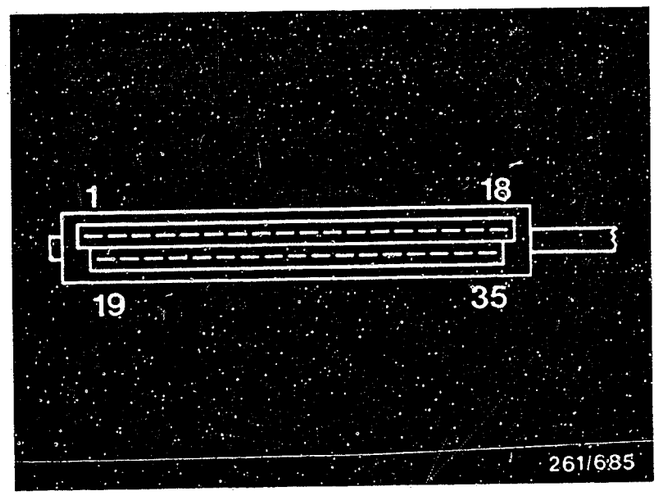
V

Continued on next picture page



Top view of plug for air-flow sensor

Top view of 35-pin control-unit plug of Motronic wiring harness



SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (11) CONTINUED (1)

V

Using ohmmeter, check leads from air-flow sensor to control-unit plug for open circuit and short circuit to ground (insulation damage).

These are the leads from the air-flow sensor term. 2 to control-unit plug term. 7 as well as from term. 3 to term. 9 and from term. 4 to term. 6.

Watch for worn insulation and loose contacts.

Leads O.K.?

N> Eliminate contact resistances, open circuits or short circuits on leads.

Y

V

With flashing code 73, also check the leads to the control-unit plug term. 6 and term. 9 for incorrect connection between one another (short circuit).

For testing, disconnect plug from air-flow sensor.

Watch for worn insulation and loose contacts.

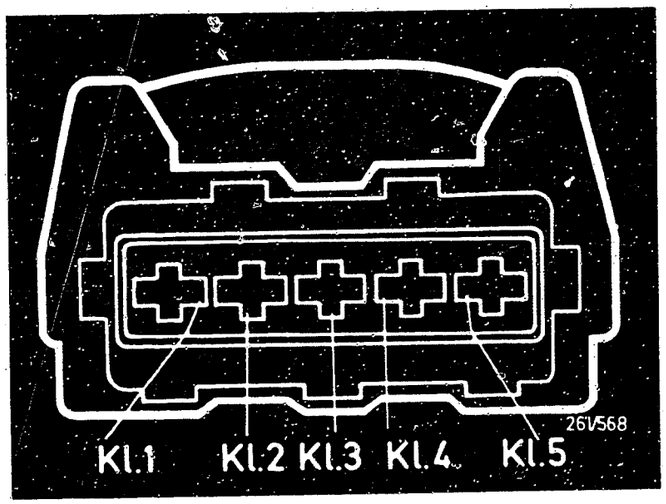
Resistance value infinity Ω ?

N> Eliminate short circuit/ insulation damage.

Y

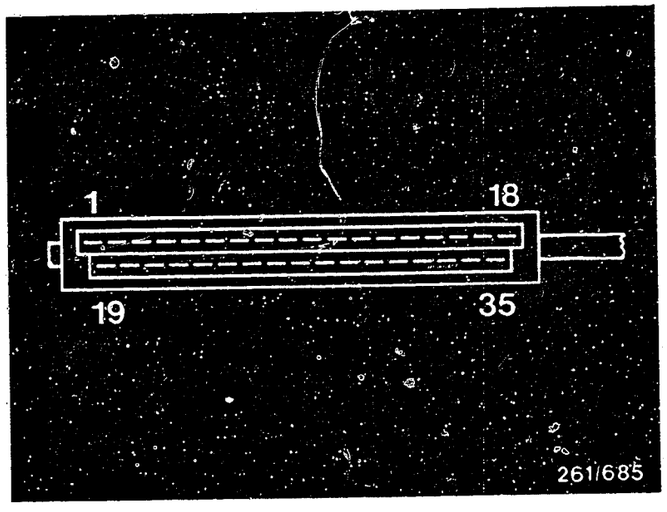
V

Continued on next picture page



Top view of plug for air-flow sensor

Top view of 35-pin control-unit plug of Motronic wiring harness



SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (11) CONTINUED (2)

V

With flashing code 74, also check the leads from the control unit term. 6 and term. 7 to air-flow sensor term. 4 and term. 2 for incorrect connection to positive voltage:

Connect plugs to air-flow sensor and control unit.

Push back rubber sleeve on plug of air-flow sensor.

Switch on ignition.

Connect voltmeter to ground and, one after the other, with positive terminal, to term. 4 and term. 2 of air-flow sensor.

Set values:
At term. 4 no voltage,
at term. 2 voltage less than 4,5 V.

Set values obtained?

N>

* Visually examine leads for contact (worn insulation).

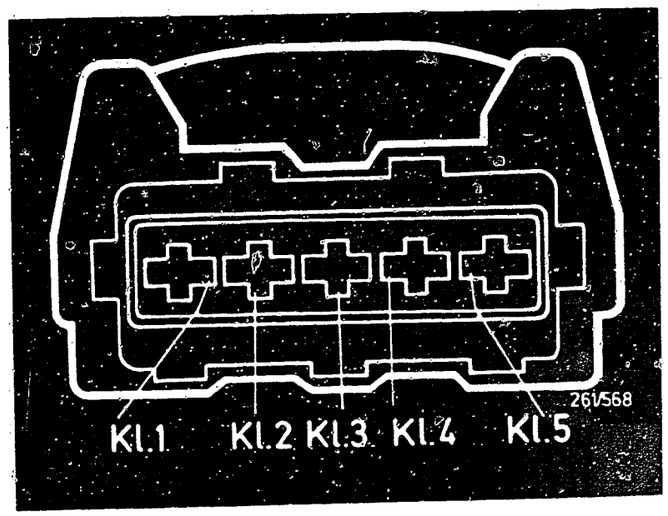
* Air-flow sensor defective.

* Control unit defective.

Y

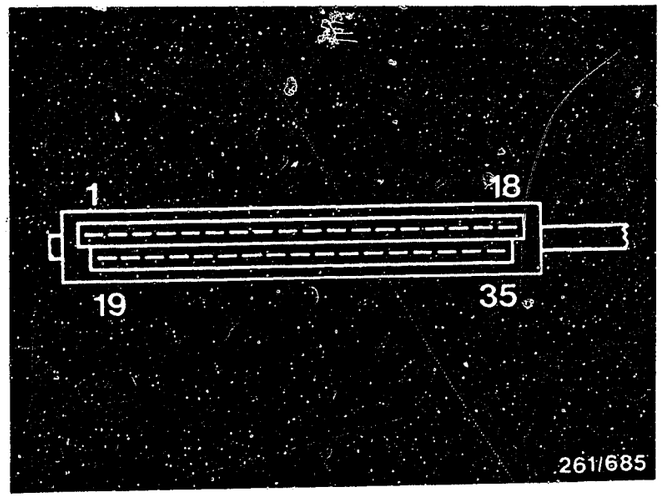
V

Return to self-diagnosis test table B11



Top view of plug for air-flow sensor

Top view of 35-pin control-unit plug of Motronic wiring harness



TROUBLE-SHOOTING PROGRAM (1)

V

* Check power supply to control unit:

Switch off ignition.

Disconnect control-unit plug (top picture).

Connect voltmeter to disconnected control-unit plug term. 35 (+) and term. 5 (-).

Switch on ignition.

SET VALUE: Battery voltage

Set value obtained?

N>

Switch off ignition.

1. Connect ohmmeter to disconnected control-unit plug term. 5 and ground lead for control unit (bottom picture).

   Ohmmeter must indicate approx. 0 Ω (continuity).

   Eliminate open circuit or contact resistance at ground terminal.

Y

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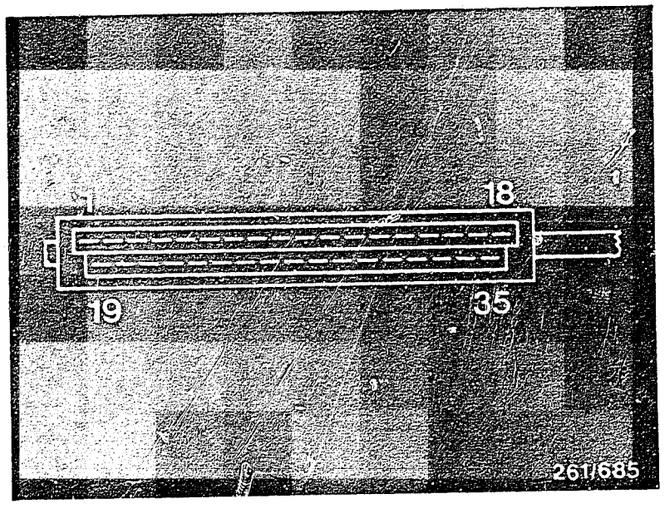
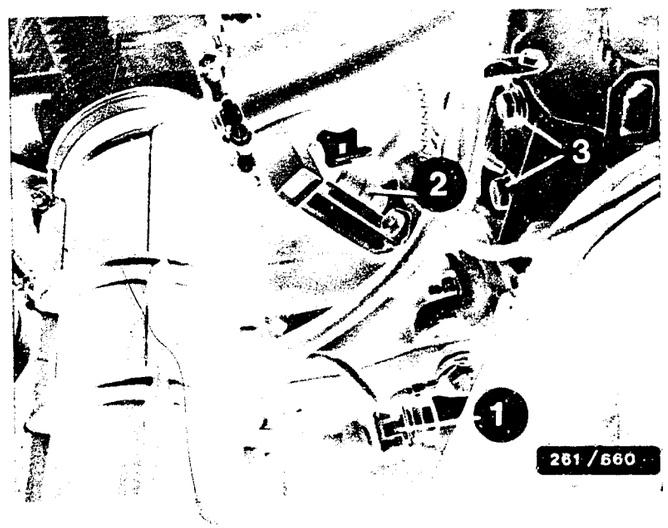
Continued on next picture page



Top view of 35-pin control-unit plug of Motronic wiring harness

1 = Temperature sensor (engine)
2 = Injection valve
3 = Ground terminals



TROUBLE-SHOOTING PROGRAM (1) CONTINUED (1)

2. Check the following lead for continuity:
From control unit term. 35 to relay 87.

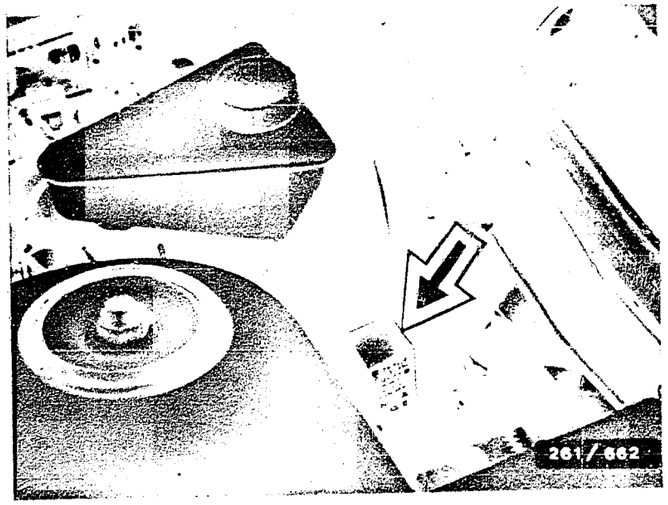
3. Measure voltages at relay:

3.1 Disconnect relay and connect voltmeter to base term. 86(+) and term. 85(-).
Switch on ignition.
Voltmeter must indicate battery voltage. If not, check leads from ignition lock term. 15 to relay term. 86
and from relay term. 85 to ground terminal for continuity.

3.2 Connect voltmeter to relay base term. 30(+) and term. 85(-).
Battery voltage must be measured.
If not, check lead to positive battery terminal.

3.3 Connect voltmeter to relay base term. 87(+) and term. 85(-).
Switch on ignition.
Battery voltage must be measured.
If not, relay defective.

4. Relay defective (top picture)



Arrow = Motronic relay (cover removed)

Return to trouble-shooting chart B03

D03 — <⟹>

D04 — <⟹>

* Check internal resistance engine-speed/reference-mark sensor:

Take apart plug connector to sensor.

Connect ohmmeter to plug to sensor between term. 23(2) and term. 25(1).

Set value: See brief instructions

Set value obtained?

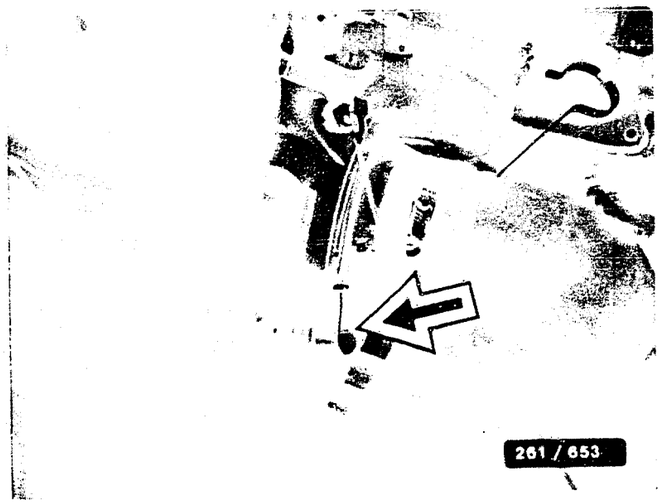
N>

Sensor defective -> replace.

Notes on replacement:

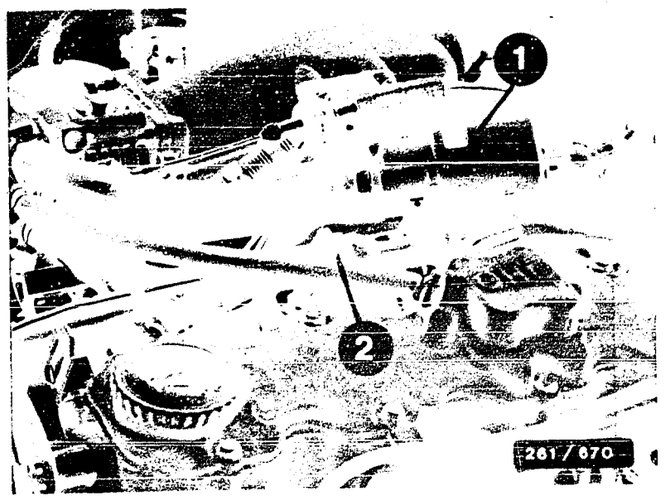
Unscrew fastening screw and withdraw sensor. If stiff, help by turning and with screwdriver.

Do not take sensor out of protective sleeve until just before installation.
Before installing the sensor, make sure that there are no metallic parts sticking to the sensor (sensors contain permanent magnets).
Grease sensor with Longterm 2.
Press sensor by hand into the hole as far as it will go.
Do not use force. Do not knock.
Make sure that the spring contacts in the plug are correctly seated. Spring contacts must not allow themselves to be pushed back and must be free from corrosion.
Plug connector must latch in.



Arrow = Engine-speed/ reference-mark sensor

1 = Idle actuator
2 = Plug connector of engine-speed/reference-mark sensor



Continued on next picture page

TROUBLE-SHOOTING PROGRAM (2) CONTINUED (1)

Check engine-speed/reference-mark sensor for short circuit to ground (insulation damage):

Switch off ignition.
Disconnect plug from control unit.
Sensor plug connector connected.
Connect ohmmeter to control-unit plug term. 23 and ground.
Set value: Infinity Ω

Watch for worn insulation and loose contacts.

Set value obtained?

N>

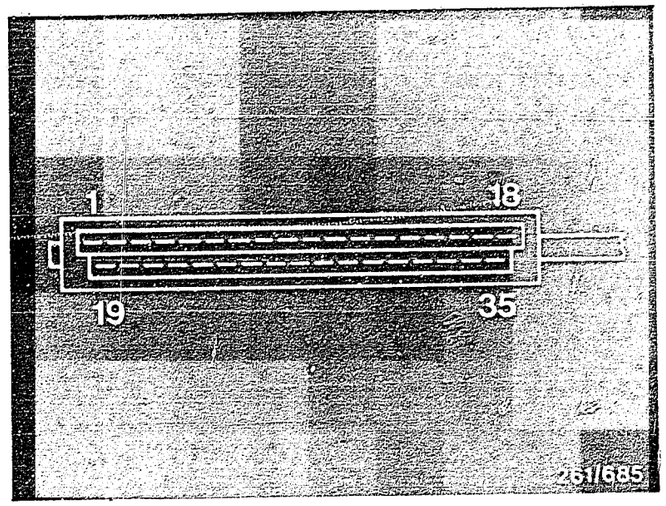
Set value less than 100 k Ω : Repair defective lead from control unit term. 23 or term. 25 to sensor plug.

If sensor lead defective, replace sensor.

Y

Continued on next picture page

D07 — <⟹>



Top view of 35-pin control-unit plug of Motronic wiring harness

D08 — <⟹>

TROUBLE-SHOOTING PROGRAM (2) CONTINUED (2)

V

Check the following leads for open circuit with ohmmeter:

From control-unit plug term. 23 to sensor plug connector term. 2 and from control-unit plug term. 25 to sensor plug connector term. 1.

Set values: approx. 0 Ω

Check plug for corrosion and loose contact.
Contacts must not allow themselves to be pushed back.

Set values obtained?
Contacts O.K.?

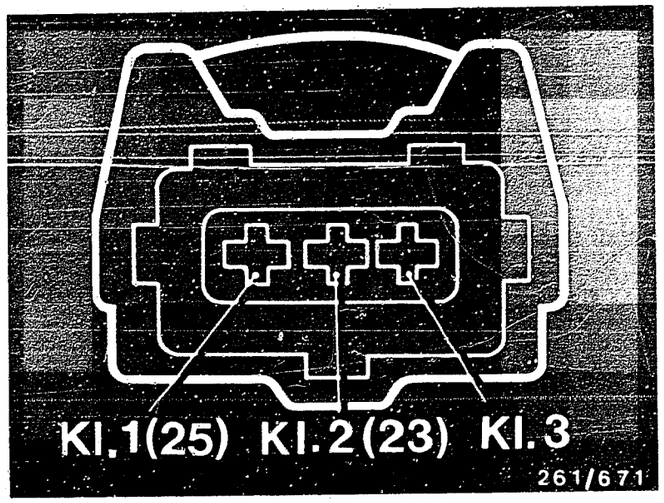
N>

Repair defective lead/plug.

Y

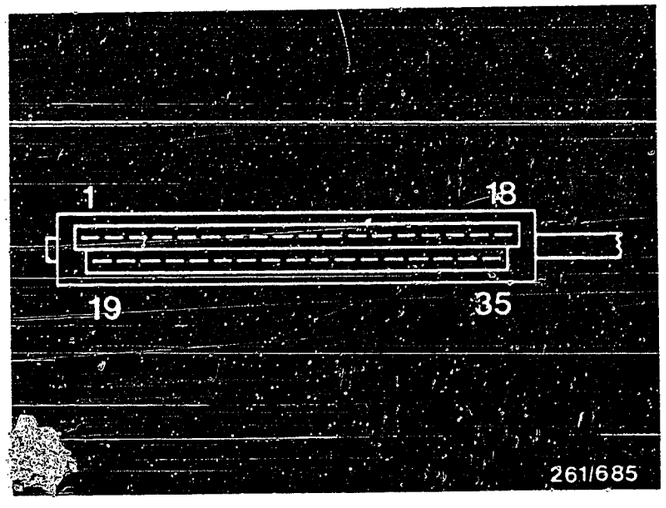
V

Continued on next picture page



Top view of plug of engine-speed/reference-mark sensor
Term. 3 = Shielding lead

Top view of 35-pin control-unit plug of Motronic wiring harness



TROUBLE-SHOOTING PROGRAM (2) CONTINUED (3)

V

Check signal from engine-speed/ reference-mark sensor. N>

Take apart sensor plug connector.

Set motortester to special input.
Lever at left-hand stop (calibrated voltage range).

Connect special cable to plug of sensor:
Red tester clamp to term. 1 of sensor plug, black tester clamp to term. 2 (negative, center contact).

Start engine.

Set value: See top picture.

Read off voltage.

N o t e:
With the reference-mark signal, the negative amplitutde must appear first.

Signal O.K.?

V

Continued on next picture page

1. No signal or signal too small:

Measuring leads incorrectly connected.

Cranking speed less than 200 min-1:
Charge battery.

Sensor air gap too big.
Nominal air gap:
0,8 mm ± 0.3.

Sensor mechanically defective, replace.

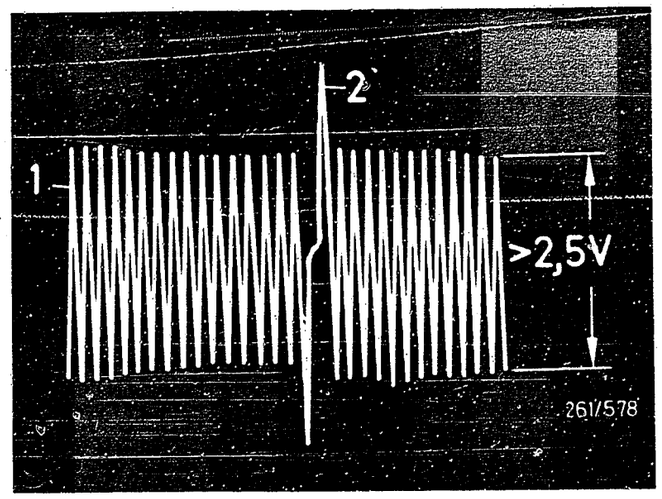
2. Incorrect signal:

Ring gear defective.
Note: Reference-mark signal is formed by several missing teeth in succession.

Positive amplitude appearing first: measuring leads incorrectly connected or sensor leads to control unit mixed up.
Rectify in accordance with circuit diagram.

V

Continued on next picture page



1 = Engine-speed signal
2 = Reference-mark signal

Sensor defective –> replace.

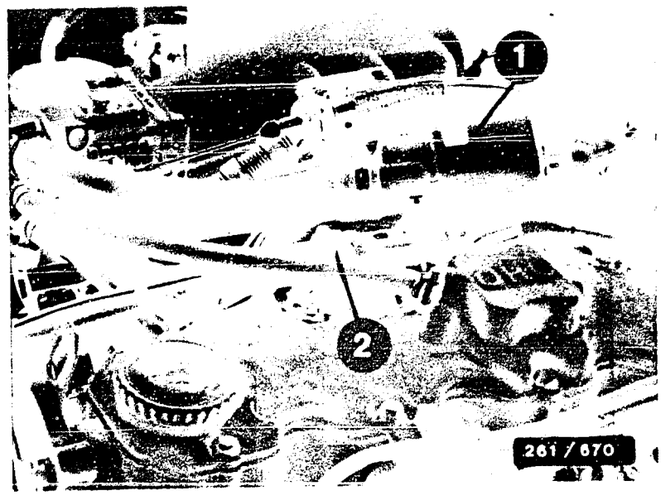
Notes on replacement:

Unscrew fastening screw and withdraw sensor. If stiff, help by turning and with screwdriver.

Do not take sensor out of protective sleeve until just before installation.
Before installing the sensor, make sure that there are no metallic parts sticking to the sensor (sensors contain permanent magnets).
Grease sensor with Longterm 2.
Press sensor by hand into the hole as far as it will go.
Do not use force. Do not knock.
Make sure that the spring contacts in the plug are correctly seated. Spring contacts must not allow themselves to be pushed back and must be free from corrosion.
Plug connector must latch in.

Arrow = Engine-speed/ reference-mark sensor

1 = Idle actuator
2 = Plug connector of engine-speed/reference-mark sensor



Return to trouble-shooting chart B03

TROUBLE-SHOOTING PROGRAM (3)

V

Testing fuel pressure with engine stopped

Measure pressure upstream of pressure regulator. Measurement point in fuel-injection tubing to fuel-distribution pipe or at pressure damper (if provided).

Detach fuel hose.
IMPORTANT!
Catch fuel which emerges.
Danger of fire in the event of warm engine and electric sparks.
Connect up pressure measuring device KDJE-P100; close valve screw. Use 3-way line KDJE-P100/13 (hose connection) for connection purposes.
Make sure connection does not leak.
Detach Motronic relay.
Fit jumper between term. 87b and term. 30 in connection frame.

Fuel pressure
SET VALUE: See brief instructions

Is set value attained?

N>

1.Electrical testing

No or not enough fuel pressure:

*Check pump fuse.
*Measure voltage at detached pump connections.
If there is no voltage, check positive lead from pump to Motronic relay term. 87b as well as pump ground lead.
If voltage is present, continue test with item 2.

2.Hydraulic testing

2.1 Pressure too low:
Slowly pinch off fuel return line.
Caution! Do not allow pressure to increase to in excess of 6 bar.
If pressure exceeds 5 bar, renew pressure regulator.
Use new O-rings in the case of O-ring sealing technique.
Apply a small quantity of silicon grease (Ft 2 v 1).
Pressure does not increase sufficiently:
Fuel pump defective.

*Fuel filter very dirty, renew.
*Fuel-injection tubing or pressure damper (if provided) clogged -> renew.
*Strainer in tank clogged.
Corrosion in tank.
Fuel pump defective.

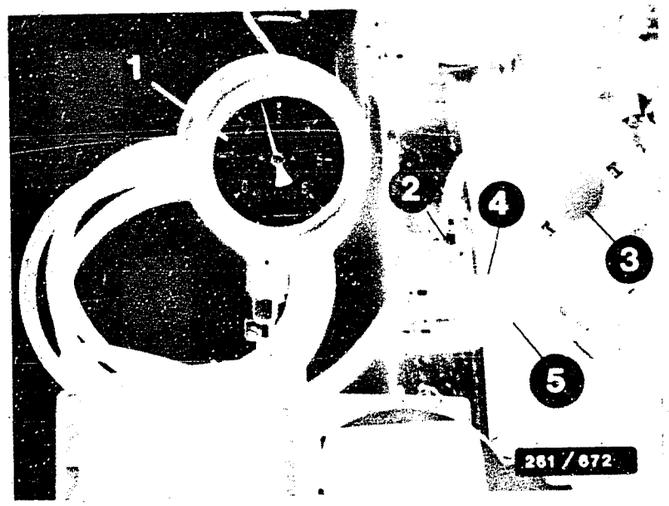
Y

V

Continued on next picture page

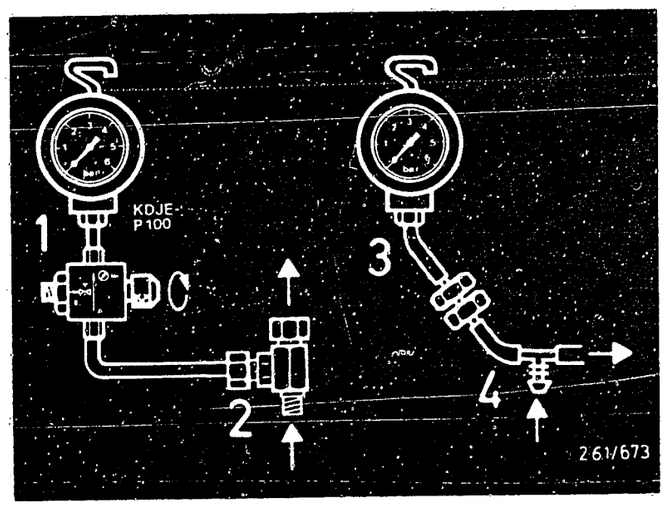
V

Continued on next picture page



1 = Pressure gauge
2 = Three-way line
3 = Fuel-line-pressure damper
4 = Delivery line
5 = Return line

1 = Pressure tester
2 = Connec. part KDJE-P100/14
3 = Pressure gauge with hose line
4 = Three-way line KDJE- P100/13



2.2 Pressure too high:
Detach fuel return hose from pressure regulator.
Attach test hose to pressure regulator and route into 1.5 l measuring jug.
Is set value attained?

*If yes, fuel return line clogged or crushed -> renew.
*If no, pressure regulator defective -> renew.

The following test sequence applies only to the fault symptom "Engine won't start".

Check whether engine starts with wire jumper in relay frame.

*If not, then continue trouble-shooting on next picture page.

*If engine starts, the following may be the cause of the trouble:

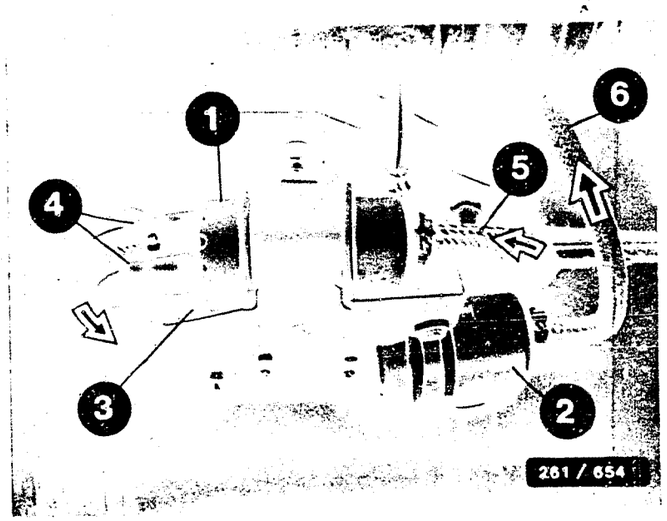
1. Open-circuit in lead from control unit term. 20 to Motronic relay term. 85b.
2. Motronic relay defective.
3. Control unit (pump output stage) defective.

Leads and components O.K.?

N>

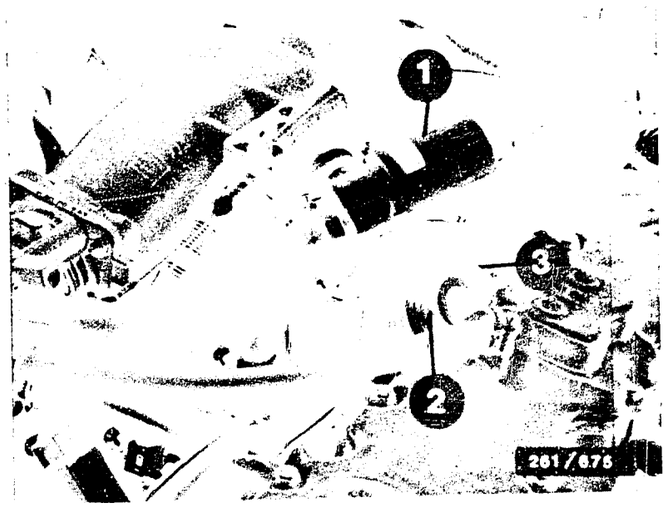
*Repair lead.
*Replace relay.
*Replace control unit.

Continued on next picture page



1 = Electric fuel pump
2 = Fuel filter
3 = Pressure damper
4 = Electrical connections
5 = Intake line
6 = Delivery line
Arrows = Direction of fuel flow

1 = Idle actuator
2 = Pressure regulator
3 = Intake-manifold pressure line



V

Check fuel delivery.

Measure fuel delivery of electric fuel pump against pressure.
Measure, therefore, at the return, after the pressure regulator.

Loosen fuel-return hose from pressure regulator.
Mount test hose on pressure regulator and lead into a 1.5 l measuring glass.
Disconnect Motronic relay.
Connect jumper into connection between term. 87b and term. 30.
The electric fuel pump must operate.
Measuring time 30 s.

Fuel delivery
SET VALUE: See brief instructions

Set value obtained?

N>

* Fuel filter very dirty -> replace.
* Fuel delivery line or pressure damper (if applicable) clogged ->.
* Voltage at electric fuel pump, with engine running, min. 12 V. If not, clean contacts, eliminate poor ground connection, replace leads.
* Check pre-supply pump (if applicable). Measuring point: line between the pumps. Delivery must be at 10 % greater than that of the electric fuel pump. If not -> replace pre-supply pump.
* If fuel-pump delivery too low -> replace electric fuel pump. Clean connecting points before loosening so that no dirt gets into the fuel system. In-tank electric fuel pumps are accessible via a closure on the tank.
* If electric fuel pump loud (vapor locks), constriction or kink in intake line -> replace.
  Strainer in tank clogged -> replace.
  Corrosion in tank -> clean or replace.
* Pressure regulator defective -> check.

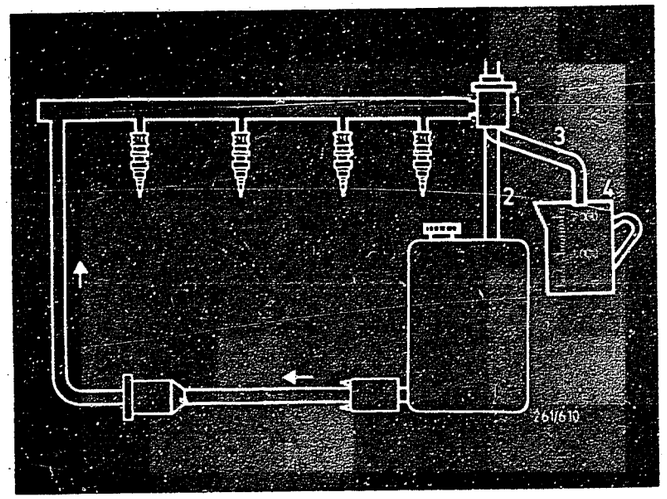
Y

After testing is completed:

Remove jumper and connect Motronic relay into connection base.
Remove test hose and mount fuel-return hose on pressure regulator. Make sure there are no leaks.

Y

Return to trouble-shooting chart B03

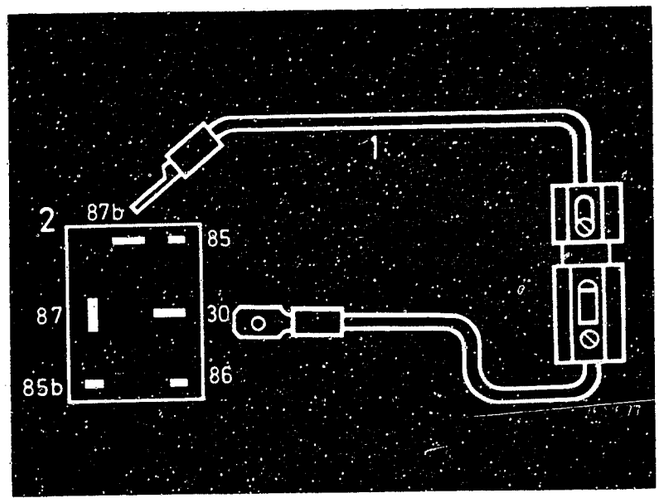


Pressureless

Fuel pressure

1 = Pressure regulator
2 = Return
3 = Test hose
4 = Measuring glass

1 = Jumper with fuse holder and 10 A fuse (user-fabricated)
2 = Top view of connection base



TROUBLE-SHOOTING PROGRAM (4)

V

Check solenoid-operated injection valves with engine running. N>

With engine running, disconnect injection-valve connectors, individually one after the other, from the injection valves and re-connect.

Engine speed must noticeably drop if injection valve is O.K.

Set value: drop in engine speed

Set value obtained?

Y

V

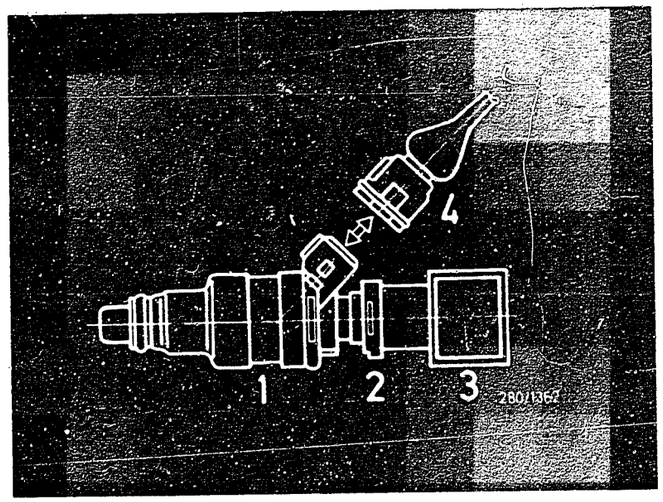
Continued on next picture page

No drop in engine speed ->

*Check injection valve with ohmmeter.
Set value: 14,5...17 Ω
If necessary, replace defective injection valve

*Check positive leads from injection valves to Motronic relay term. 87 for continuity and check negative leads to control unit term. 14.

*Replace corresponding injection valve (mechanical defect).



1 = Injection valve
2 = Holding clamp
3 = Fuel-distribution pipe
4 = Connector

TROUBLE-SHOOTING PROGRAM (4) CONTINUED (1)

V

Measure signal at solenoid-operated injection valve. Check operation and interference. N>

Connect the two-pole test lead 1 684 463 093 between an injection valve and its connector.
Connect motortester (special input) to test lead. Black clamp to vehicle ground.
Connect red clamp to one of the two connections of the test lead.

Caution: The free connection clamp of the test lead must not come into contact with vehicle ground.

Start engine or let engine run. If correctly connected, injection pulses (picture opposite) will be visible on the oscilloscope.

Set value: Picture opposite

Set value obtained?

Y

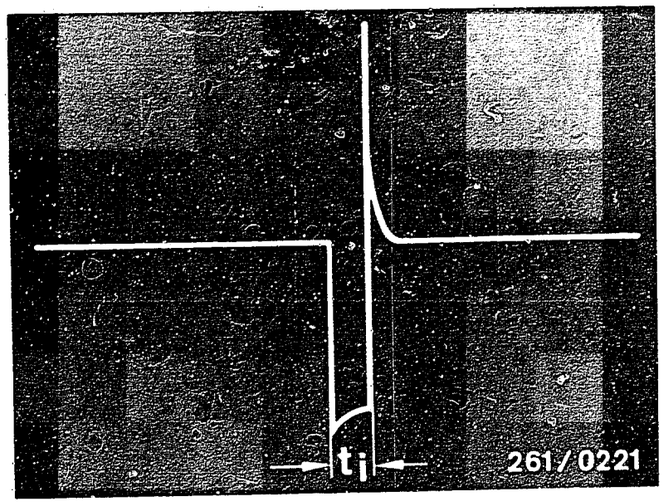
V

Continued on next picture page

* No injection signal visible:
Check positive leads from injection valves to Motronic relay term. 87 for continuity. Do the same for the negative leads to the control unit term. 14.
If leads O.K., control unit defective.

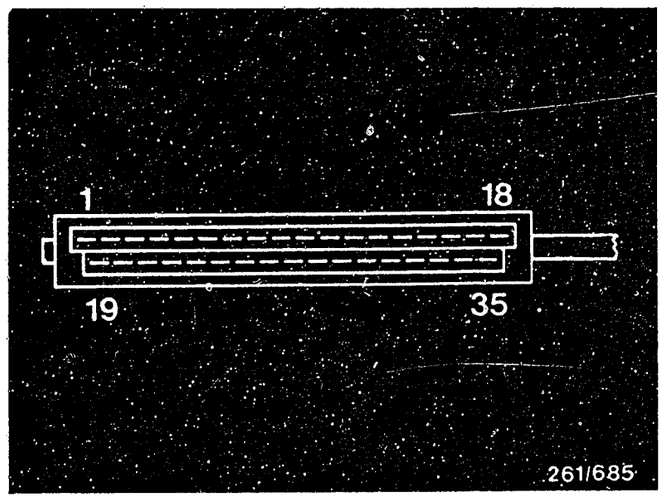
* In case of interference, check routing of leads, i.e. ensure distance between ignition cables and wiring harness. In addition, check alternator (e.g. worn carbon brushes) and regulator.

* In case of misfiring, check all injection-valve connectors and other connections:
Spring contacts in plug must be latched and must not allow themselves to be pushed back.
Contact surfaces must be bare down to the metal.
Move connections with engine running and watch for misfiring.



Injection signal
t_i = Duration of injection

Top view of 35-pin control-unit plug of Motronic wiring harness



TROUBLE-SHOOTING PROGRAM (4) CONTINUED (2)

Check fuel pressure with engine running.

Let engine idle.

Fuel pressure
SET VALUE: approx. 0.5 bar
lower than with engine stopped.

Set value obtained?

N>

*Intake-manifold-pressure energization of pressure regulator not O.K. Hose line between pressure regulator and intake manifold clogged or leaking -> replace.
Hose line dropped off -> re-connect.

*If intake-manifold-pressure energization O.K. -> replace pressure regulator.

Y

Check fuel pressure after switching off engine (checking for leaks).

Fuel pressure
SET VALUE: min. 1.0 bar
after 20 minutes.

Set value obtained?

N>

*Leaking at joints between components, fuel hoses and fuel lines -> tighten hose binder or replace hose.

*Pressure regulator (diagphragm) leaking -> replace.

*Electric fuel pump (non-return valve) leaking.
With screw-type non-return valve -> replace.
With integral non-return valve -> replace electric fuel pump.

*Pressure damper or fuel filter leaking -> replace.

Y

After testing is completed:

Remove jumper and connect Motronic relay in connection base.

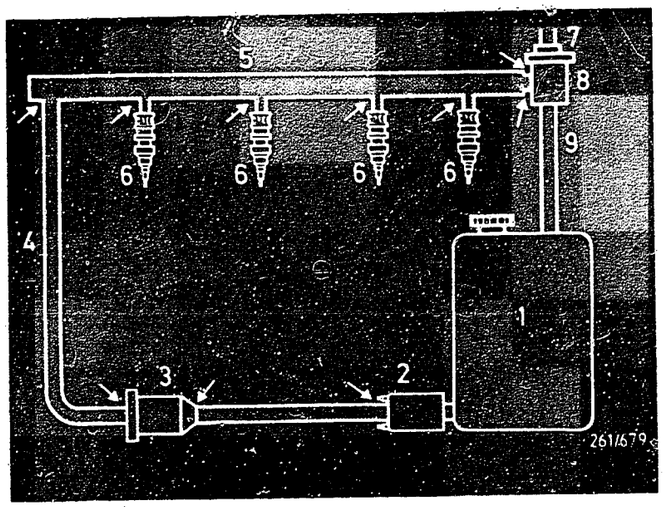
Remove pressure tester.
Connect fuel-inlet hose on fuel-distribution pipe.

Make sure there are no leaks.

Y

Continued on next picture page

Continued on next picture page



1 = Fuel tank
2 = Electric fuel pump
3 = Fuel filter
4 = Inlet, delivery line
5 = Fuel-distribution pipe
6 = Injection valves
7 = Intake-manifold pressure connection
8 = Pressure regulator
9 = Return line

Arrows = Possible leaks

If set value not obtained:

* Injection valve(s) leaking at connection point to fuel-distribution pipe -> replace O-ring (see next picture page).

* Check injection valve(s) (needle seat) for leaks:

Remove complete fuel-distribution pipe. Inlet and return remain connected. Withdraw all injection valves simultaneously out of guides in intake manifold.

Connect jumper to connection base (Motronic relay) between term. 87b and term. 30 Electricl fuel pump must operate.

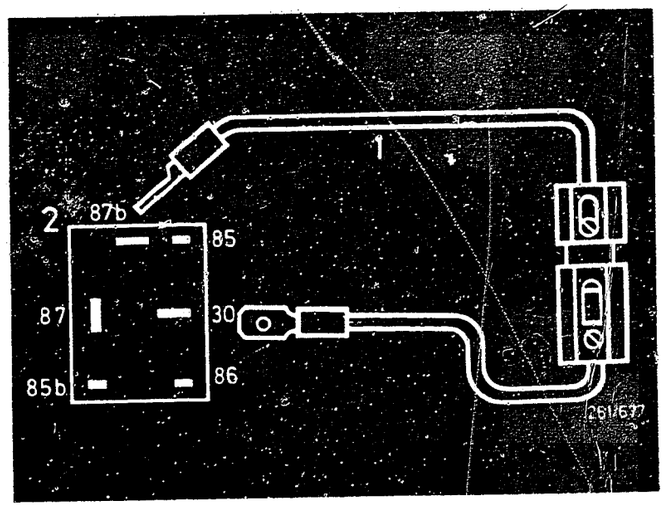
SET VALUE:
Within 60 s no drop may fall from the injecton valve. In case of fault -> replace injection valve.

Removal:
Disconnect connector. Withdraw holding clamp. Take out injection valve.

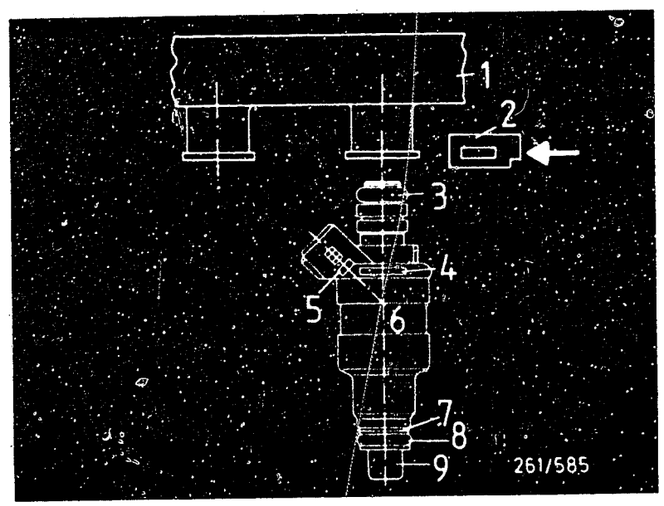
C a u t i o n:
Catch escaping fuel; it must not get onto hot parts of the engine.

Continued on next picture page

Continued on next picture page



1 = Jumper with fuse holder and 10 A fuse (user-fabricated)
2 = Top view of connection base



1 = Fuel-distribution pipe
2 = Holding clamp
3 = Upper O-ring
4 = Part number
5 = Date of manufacture
6 = Injection valve
7 = Supporting plate
8 = Lower O-ring
9 = Protective sleeve

If injection valve (needle seat) is leakproof but O-ring is defective, then renew O-ring.

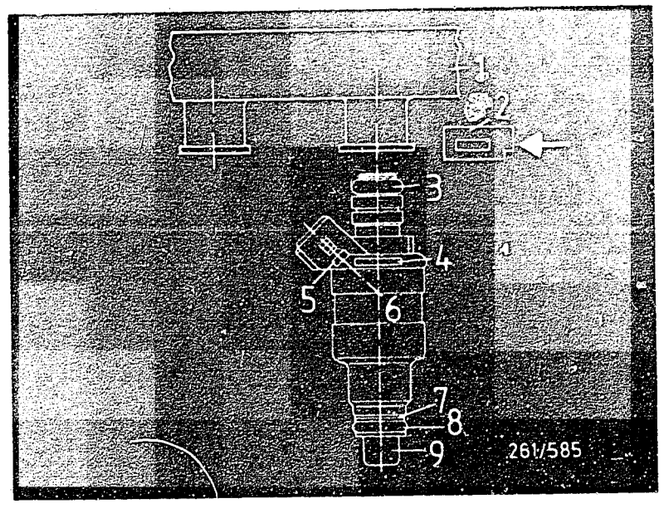
Use new parts set.
Caution! Do not damage protection sleeve and valve needle.

Renew upper O-ring (fuel distributor) if it is damaged.

Cut up lower O-ring (intake manifold) if it is defective.
Fit new O-ring over protection sleeve and its beading.

Installation:
Only grease O-rings slightly (silicone grease Ft 2 v 1).
Attach injection valve to fuel distributor.
Slip retaining clip into groove and allow it to engage.
Check for fuel leaks.
Fit connector.

Install complete fuel distributor.
In doing so, press all injection valves evenly into intake-manifold guide.
Caution!
Do not damage O-rings and/or valve needles.
Make sure there are no intake-manifold leaks.



1 = Fuel-distribution pipe
2 = Holding clamp
3 = Upper O-ring
4 = Part number
5 = Date of manufacture
6 = Injection valve
7 = Supporting plate
8 = Lower O-ring
9 = Protective sleeve

Continued on next picture page

TROUBLE-SHOOTING PROGRAM (4) CONTINUED (5)

V

Increased noise from electric fuel pump.

In case of:
-high outside temperatures,
-high fuel temperatures,
-fuel tank almost empty,
-lengthy full-load driving or
-at idle,
-use of winter fuel at warmish outside temperatures,
vapor locks in the intake line may lead to noises at the electric fuel pump.

Are pump noises normal?

N>

*Pump suspension (vibration damper) defective -> replace.

*Intake line constricted or kinked -> replace.

*Strainer in fuel tank clogged -> replace.

*Intake or delivery line transmitting pump noises to vehicle body -> lay lines so that they are free of tension, or replace if necessary.

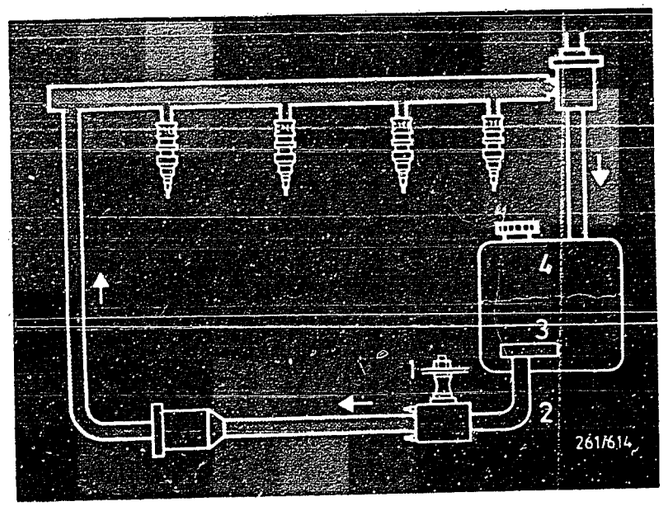
*If fuel tank almost empty -> fill up.

Y

V

Return to trouble-shooting chart B03

E03 — <==>



1 = Pump mounting
2 = Intake line
3 = Intake strainer
4 = Fuel level

E04 — <==>

TROUBLE-SHOOTING PROGRAM (5)

V

* Mechanical check of air-flow sensor:

Remove air-flow sensor.

Open sensor flap by hand.

Sensor flap must open with uniform ease as far as it will go and must automatically close again as far as it will go.

Sensor flap must not catch when opening.

Watch for signs of rubbing.

Clean air-flow sensor if inside is very dirty and rub out with a lint-free cloth.

Does sensor flap open with uniform ease?

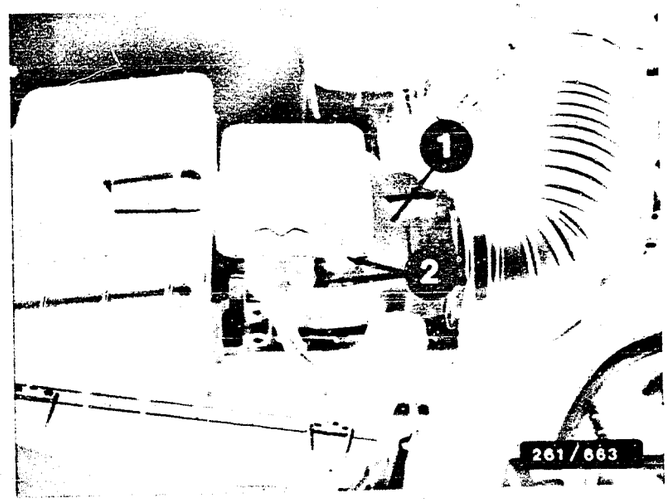
No signs of rubbing visible?

N> Replace air-flow sensor.

Y

V

Continued on next picture page



1 = Air-flow sensor
2 = CO potentiometer

TROUBLE-SHOOTING PROGRAM (5) CONTINUED (1)

V

Electrical test of air-flow sensor:

Remove air-flow sensor.

Leave plug on. Push back rubber sleeve on plug.
Connect voltmeter to plug term. 2 (+) and term. 4 (-) with test prods.
Switch on ignition.
Measure voltage.

SET VALUES:
Sensor flap in rest position:
100...300 mV

Open sensor flap by hand as far as it will go:
greater than 4,2 V

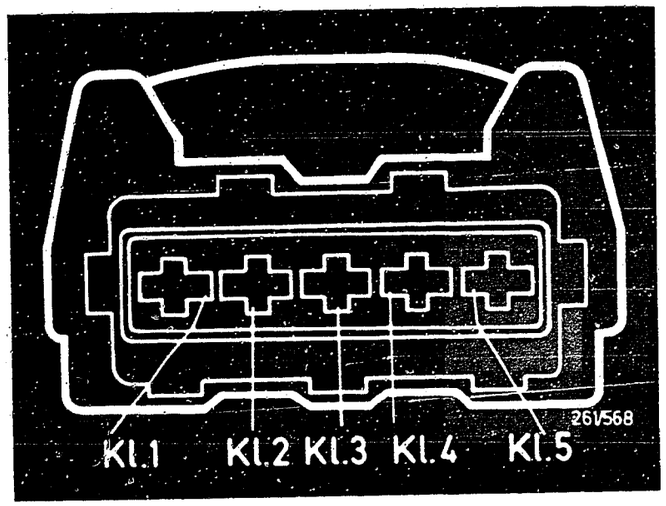
Set values obtained?

N> Replace air-flow sensor.

Y

V

Continued on next picture page



Top view of plug for air-flow sensor

TROUBLE-SHOOTING PROGRAM (5) CONTINUED (2)

V

Check potentiometer in air-flow sensor with oscilloscope (noise test).

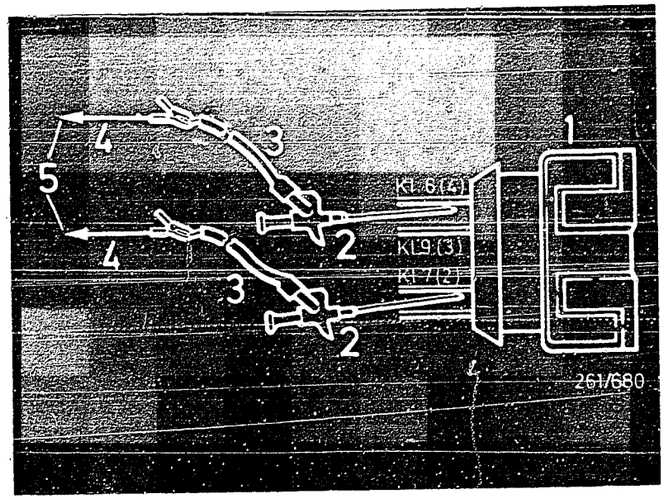
* Remove air-flow sensor. Leave electric plug on. Push back rubber sleeve. Set motortester to special input, and, using the special cable, connect to air-flow sensor at term. 2, red clip, and at term. 4, black clip.

* User-fabrication of adapter lead: Two approx. 1 m long leads, approx. 1,0 mm ^{2} cross section. 2 measuring prods are attached to one end. At the other end, strip off approx. 2 cm insulation and connect to the clamps of the special-input connecting lead.
C a u t i o n:
Insulate bare connecting points of adapter lead (risk of short circuit).
Measure carefully into the plug of the air-flow sensor. Do not bend spring contacts.
Set control lever for image adjustment on motortester all the way to the left (calibrated setting).

Y

V

Continued on next picture page



1 = Air-flow sensor plug
2 = Test prod
3 = Adapter lead (User-fabricated)
4 = Special-input connecting lead
5 = Motortester special input

TROUBLE-SHOOTING PROGRAM (5) CONTINUED (3)

V

* Switch on ignition.

* Deflect air-flow sensor jerkily several times.

  If air-flow sensor O.K., a continuous stroke signal must be visible on the oscilloscope.

  If air-flow sensor defective, a noise signal will appear similar to the one shown opposite.

  Disconnect adapter lead after testing and connect rubber sleeve properly.

  Mount air-flow sensor.

  Connect all hoses and tighten (no leaks).

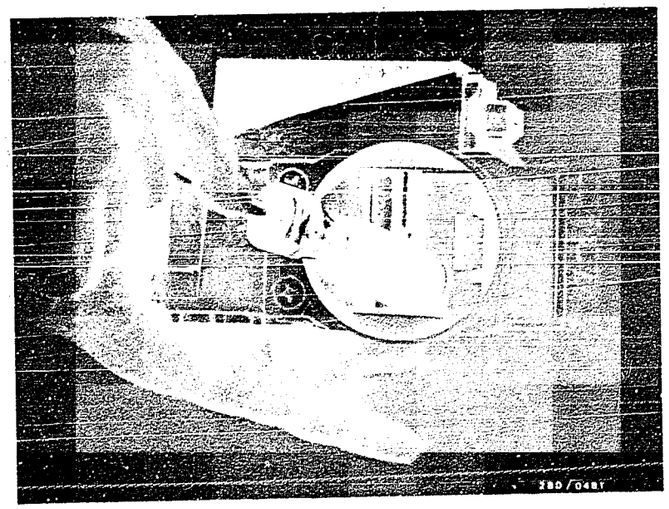
Signal O.K.?

N> Replace air-flow sensor.

Y

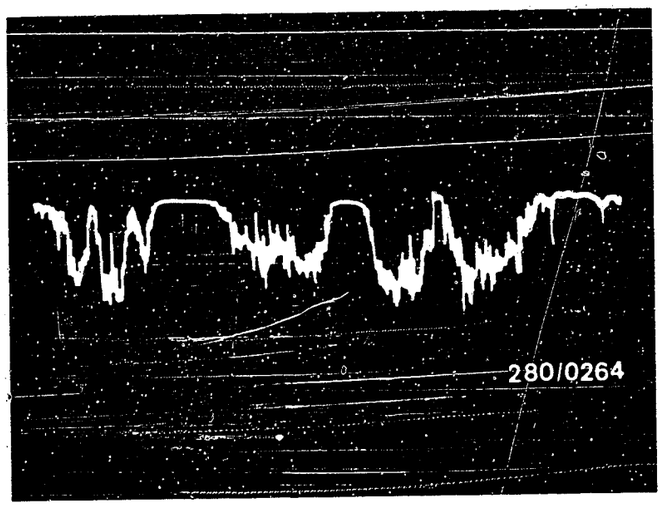
V

Continued on next picture page



Opening the air-flow sensor flap

Noise signal if air-flow sensor defective



Check idle contact:

Disconnect plug from throttle-valve switch.
Throttle valve closed.
Connect ohmmeter to throttle-valve switch term. 2 and term. 18.
Set value: approx. 0 Ω (continuity).

Open throttle valve:
Reading must change to infinity Ω after the throttle valve has been opened slightly.

Does resistance value change from 0 Ω to infinity Ω ?

N>

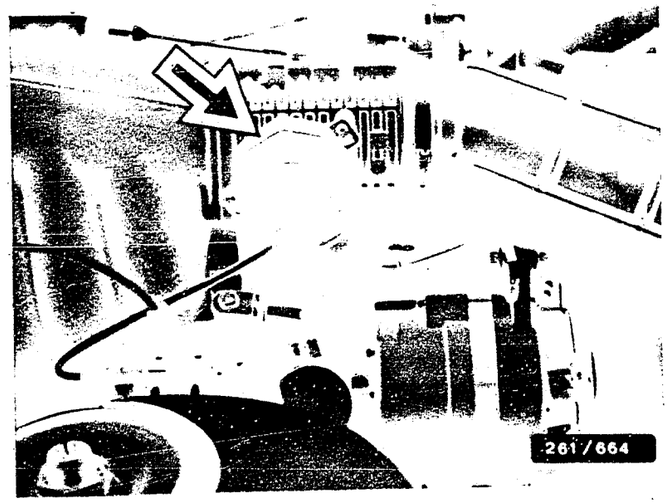
* Idle contact not closing (reading remains constant at infinity Ω) or idle contact opening too late:
Adjust throttle-valve switch.
* Requirements for throttle-valve switch adjustment:
+ Throttle valve correctly adjusted? It must come up against the stop screw with the lever just before it sticks.
Lock screw against turning.
+ Adjust throttle cable/linkage free of tension.
If kinked -> replace.

Adjusting the throttle-valve switch:
Slightly loosen fastening screws. Connect ohmmeter to throttle-valve switch between term. 2 and term. 18. Turn throttle-valve switch until the idle contact closes (microswitch clicks audibly).
Reading 0 Ω . If not => replace throttle-valve switch.

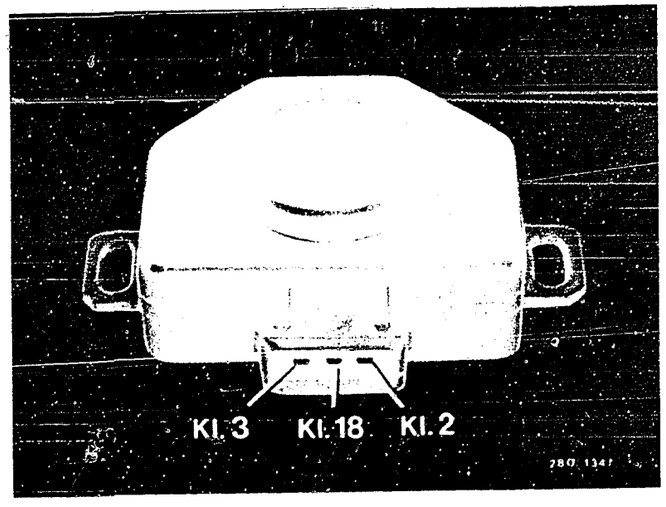
Checking the adjustment:
Pull slightly on throttle cable. Idle contact must open (microswitch clicks audibly).

Reading: Infinity Ω .

Continued on next picture page



Arrow = Throttle-valve switch



TROUBLE-SHOOTING PROGRAM (5) CONTINUED (5)

Check the following leads for open circuit with ohmmeter: From control unit term. 2 to throttle-valve switch term. 2 as well as from throttle-valve switch term. 18 to ground.

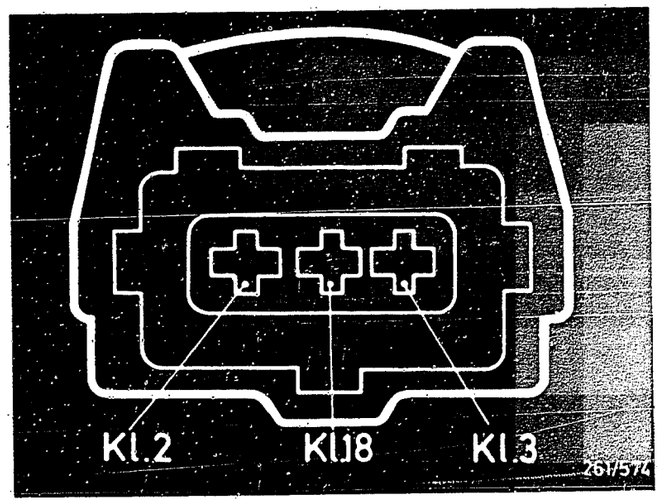
Set values: 0 Ω

Check plug for corrosion and loose contact. Contacts must not allow themselves to be pushed back.

Set values obtained? Contacts O.K.?

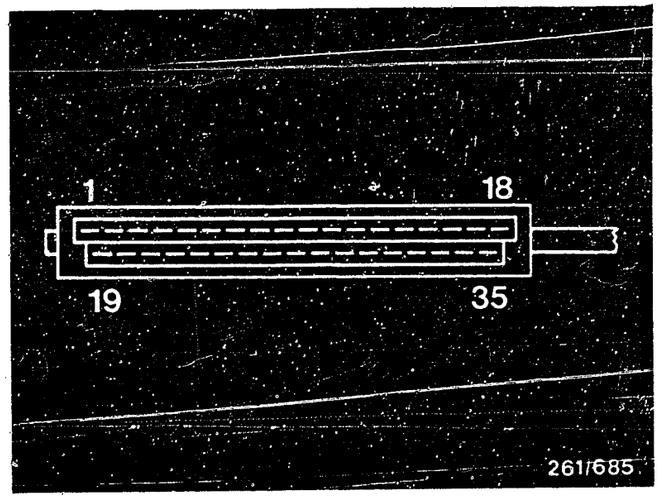
N> Repair defective lead/plug.

Return to trouble-shooting chart B03



Throttle-valve switch plug

Top view of 35-pin control-unit plug of Motronic wiring harness



TROUBLE-SHOOTING PROGRAM (6)

Check full-load contact:

Disconnect plug from throttle-valve switch.
Connect ohmmeter to throttle-valve switch term. 3 and term. 18.
Open throttle valve as far as it will go:

Set value:
Before the full-load stop, the reading changes from infinity Ω to 0 Ω .

Does the reading change from infinity Ω to 0 Ω ?

N>

Full-load contact not closing (reading remains constant at infinity Ω):
Check whether throttle valve is mechanically able to open fully. If mechanics are O.K., replace throttle-valve switch.
N o t e:
The full-load contact cannot be adjusted. If the idle contact is correctly adjusted, the setting of the full-load contact will also be correct.

Y

Check the following lead for open circuit with ohmmeter:
From control unit term. 3 to throttle-valve switch term. 3

Set value: approx. 0 Ω

Check plug for corrosion and loose contact.
Contacts must now allow themselves to be pushed back.

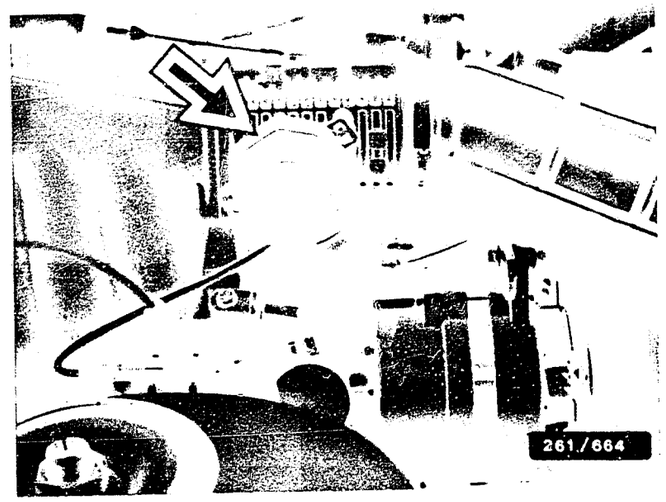
Set value obtained?
Contacts O.K.?

N>

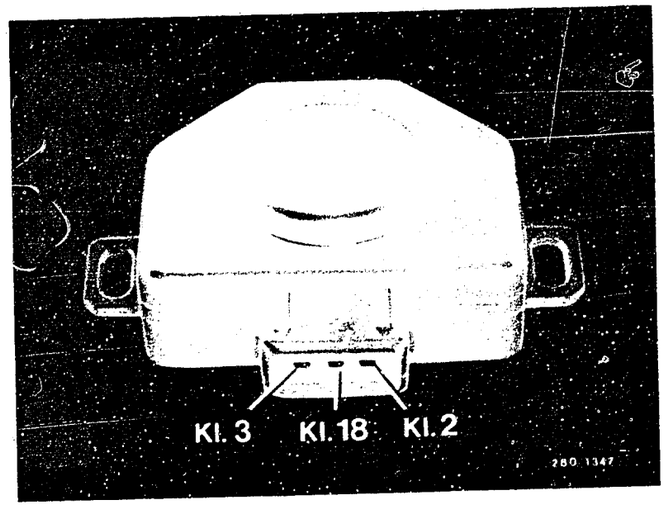
Repair defective lead/plug.

Y

Return to trouble-shooting chart B03



Arrow = Throttle-valve switch



TROUBLE-SHOOTING PROGRAM (7)

Check air-intake system

Check whether hoses of air-intake system are correctly connected, not kinked or damaged.
Check whether oil dipstick has been inserted as far as it will go and whether the seal on the oil filler-neck cap is O.K.
With catalytic-converter models, check also that the tank-ventilation system (if applicable) is not leaking (visual examination).

Are all hoses O.K.?

N> Replace hoses if necessary. Eliminate leaks by means of new seals or by retightening the hose clamps.

Y

Continued on next picture page

E19 — <⟹>

E20 — <⟹>

TROUBLE-SHOOTING PROGRAM (7) CONTINUED (1)

Leak test on air-intake system.

Seal off exhaust tail pipe. Unscrew air-flow sensor from air-filter housing and seal off air-flow sensor duct. Disconnect hose after idle actuator. Seal off idle-actuator connection. Fully open throttle valve. Using a compressed-air gun, blow air (0.3 bar gauge pressure) into the intake manifold. Using a leak-detector spray or soapy water, spray or brush all joints. Bubbling or foaming indicates a leak.

Are all joints tight?

N> Eliminate leaks by means of new seals or by retightening the hose clamps.

Leaks may also occur at the following points: oil dipstick not securely inserted, defective seal at oil filler-neck cap etc.

Y

Return to trouble-shooting chart B03

E21 — <⟹>

E22 — <⟹>

TROUBLE-SHOOTING PROGRAM (8)

V

* Check ignition coil:

Visual examination:

Remove protective cap of ignition coil and check whether plug (see picture) is in position and/or whether any sealing compound has escaped.

Electrical test:

Measure resistance of ignition coil, primary (term. 15 and term. 1) (take resistance of test lead and test prods into account) and secondary (term. 1 and term. 4):

SET VALUES:
See brief instructions

Plug in position and/or no sealing compound escaped?

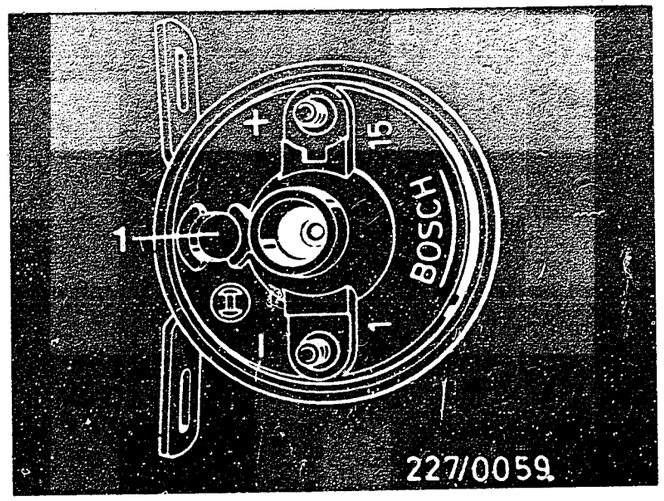
Resistance values O.K.?

N>

1. Plug not in position and/or sealing compound escaped:

   Replace ignition coil and control unit (ignition output stage defective) and check lead from ignition coil term. 1 to control unit term. 1 for continuity (0 Ω).

2. Replace ignition coil if resistance values not within tolerance.



1 = Plug

Y

V

Return to trouble-shooting chart B03

E23 — <⟹>

E24 — <⟹>

TROUBLE-SHOOTING PROGRAM (9)

V

* Check idle actuator.

*Measure winding resistance directly at idle actuator:

SET VALUE:
see brief instructions

*Check leads from control unit term. 33 to idle actuator and from the other terminal of the idle actuator to relay term. 87 (+) for continuity.
Check plug for corrosion and loose contact.
Contacts must not allow themselves to be pushed back.

*Slide of idle actuator must not stick.

Winding resistance, leads and slide O.K.?

N>

*Winding resistance not within tolerance:
Replace idle actuator.
Note direction of flow.

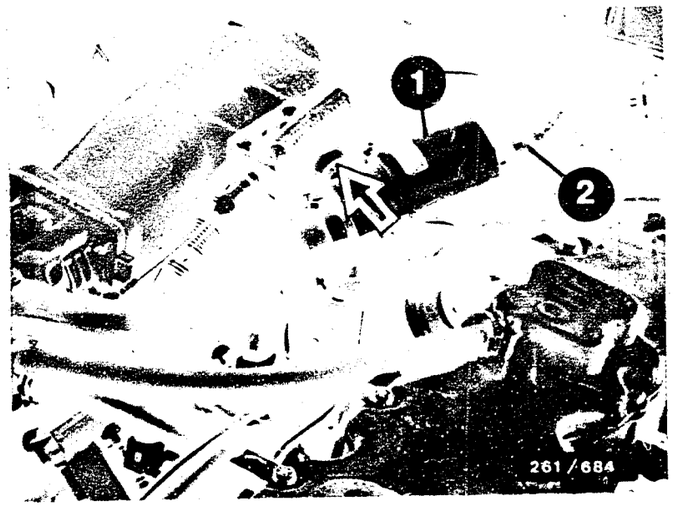
*Repair leads and plug-in connection.

*Slide mechanically damaged:
Replace idle actuator.
Note direction of flow.

Y

V

Continued on next picture page



1 = Idle actuator
2 = Plug
Arrow = Direction of flow

Check energization of idle actuator.

Switch on ignition.
Idle actuator is pulsed by the control unit and vibrates (feel by hand).

Idle actuator vibrating?

N>

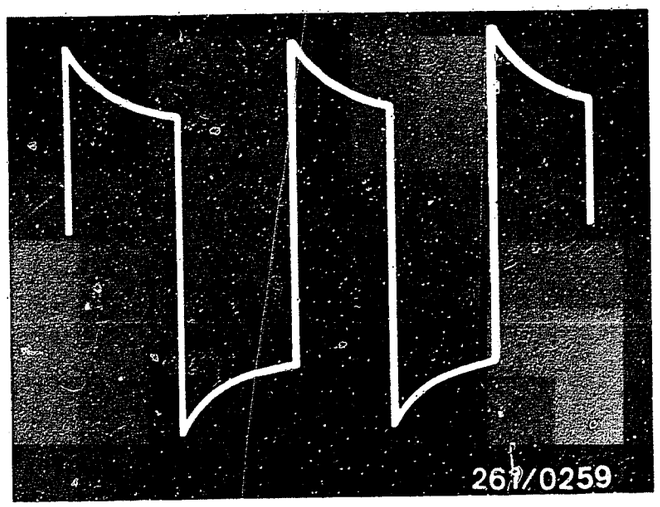
Measure signal at idle actuator:

Connect two-pole test lead 1 684 463 093 between actuator and its connector.
Connect motortester (special input) to test lead:
Black clamp to vehicle ground, red clamp to test lead term. 33 (try out which connection leads to term. 33).
Insulate bare terminals and lay to one side.
Switch on ignition.
If correctly connected, signals will be visible on the oscilloscope (top picture).

If no signals visible, replace control unit.

Y

Return to trouble-shooting chart B03



Signals at idle actuator

TROUBLE-SHOOTING PROGRAM (10)

V

* Check primary signal with oscilloscope:

Connect oscilloscope to ignition coil.

Connect Motronic control unit.

Shift gear to neutral and start.

SET VALUE:
Primary signal must be present (top picture).

Primary pattern present?

N>

Primary signal not present:

+ Check lead from ignition coil term. 1 to control unit term. 1 for continuity.

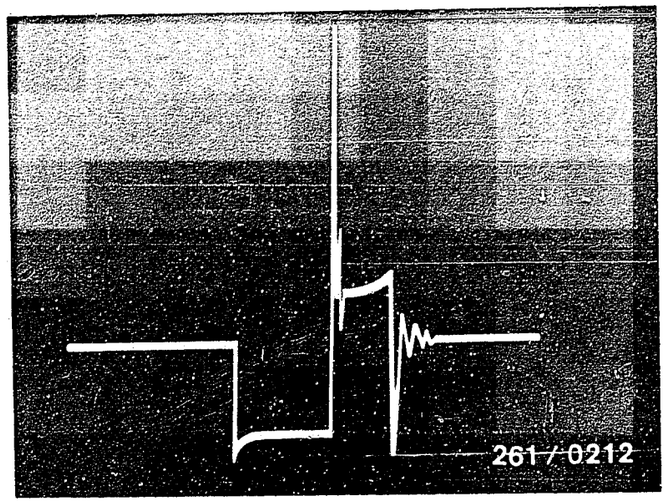
+ If lead O.K., replace control unit.

Requirements:
Power supply to control unit present and engine-speed/reference-mark signals O.K. as well as ignition coil checked.

Y

V

Continued on next picture page



Primary signal

TROUBLE-SHOOTING PROGRAM (10) CONTINUED (1)

V

Check secondary patterns of all cylinders and interference-suppression resistors.

SET VALUES for interference-suppression resistors:
see brief instructions

Secondary patterns and interference-suppresion resistors O.K.?

N>

*Distributor cap oil-fouled on outside and/or inside? Insulation damage visible?

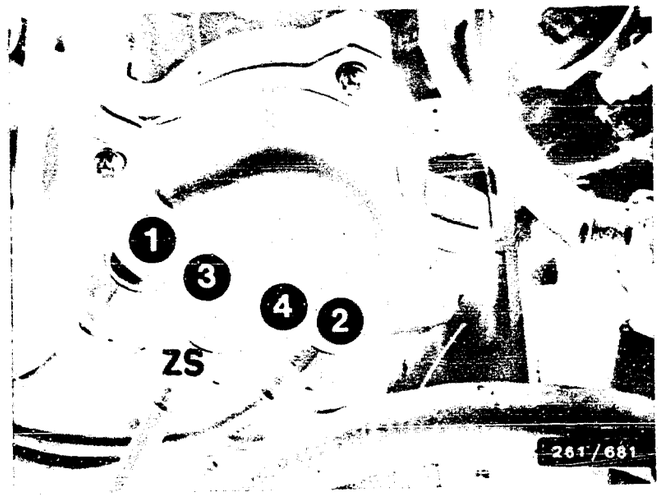
*Check interference-suppression resistors, ignition cables and spark plugs.
Note:
Ignition cables are in the form of resistance cables as standard.

*Note the cylinder numbers when connecting the ignition cables.
Do not forget hood and screening cover.

Y

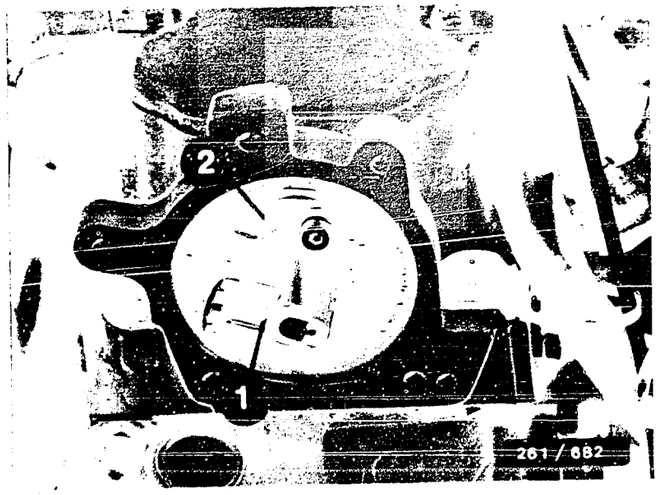
V

Return to trouble-shooting chart B03



High-voltage distributor
1 to 4 = Cylinder numbers
ZS = High-voltage lead to ignition coil

1 = Distributor rotor
2 = Cap



TROUBLE-SHOOTING PROGRAM (11)

V

Check ignition timing:

Connect motortester.

Bring engine to normal operating temperature (engine-oil temperature greater than 60°C).

Switch off all electrical equipment.

For measuring the spark-advance angle, use TDC pickup or flash timing light at ignition mark. (Top picture)

Idle speed must have the specified set value (see brief instructions); otherwise a different spark-advance angle will be indicated.

SET VALUE for spark-advance angle:

See brief instructions

Set value obtained?

N> + Idle speed correct?

+ Control unit defective.

Y

V

Return to trouble-shooting chart B03

Arrow = Ignition-timing mark (pin)

TROUBLE-SHOOTING PROGRAM (12)

V

* Check idle speed:

Connect motortester according to operating instructions. Engine at operating temperature, switch off electrical equipment. Set automatic transmission to N or P.

SET VALUE: See brief instructions

Set value obtained?

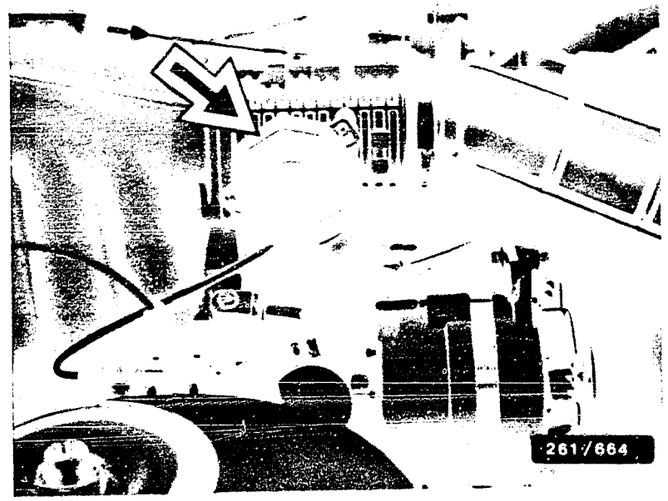
N>

* Idle contact in throttle-valve switch must be closed -> check.
* Check idle actuator.
* There is no idle-adjusting screw.
* See trouble-shooting chart for further possibilities.

Y

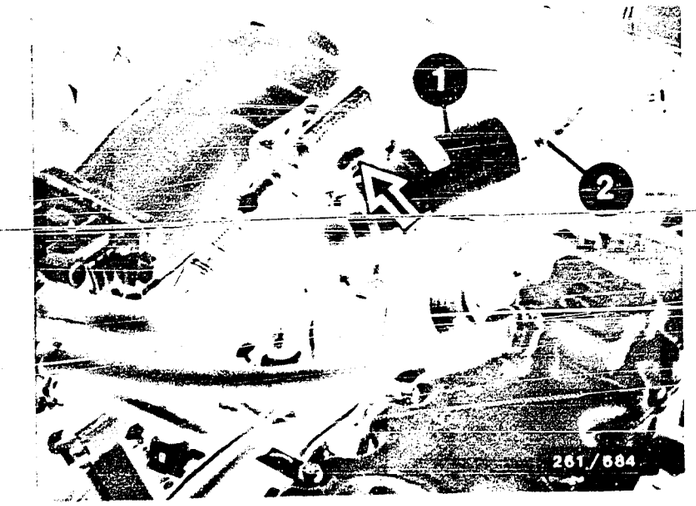
V

Continued on next picture page



Arrow = Throttle-valve switch

1 = Idle actuator
2 = Plug
Arrow = Direction of flow



TROUBLE-SHOOTING PROGRAM (12) CONTINUED (1)

V

Check exhaust gas (CO):

Connect exhaust-gas analyzer. In vehicles with catalytic converter, also at exhaust tail pipe.

Engine at operating temperature, switch off electrical equipment, set automatic transmission to N or P.
Operate engine at idle speed.

SET VALUES:

Vehicles without catalytic converter: See brief instructions.

Vehicles with catalytic converter:
0 % CO by vol.

Set values O.K.?

N>

* Adjustment possibitily for mixture (CO) on potentiometer in air-flow sensor (top picture):

Remove plug in air-flow sensor.

Turn potentiometer clockwise -> CO rises (duration of injection is lengthened).

Turn potentiometer counter-clockwise -> CO falls (duration of injection is shortened).

Adjustment range for duration of injection is
max. 0.5 ms

Insert new plug:
13 mm diameter ->
part number 1 280 508 010

In vehicles with catalytic converter, mixture adjustment is not necessary.

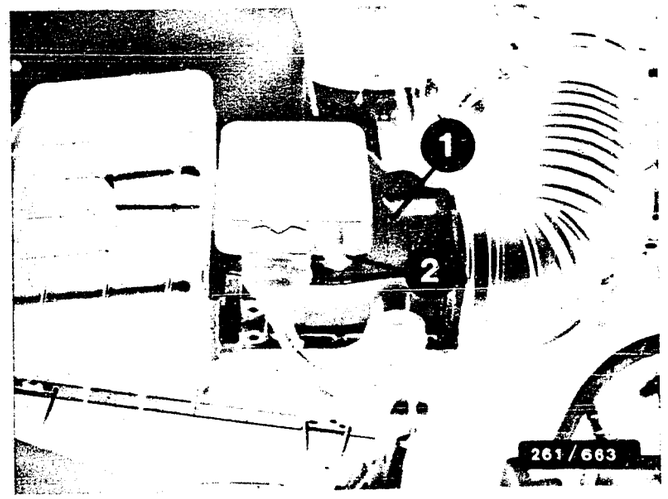
* Catalytic converter O.K.?

* See trouble-shooting chart for further possibilities.

Y

V

Return to trouble-shooting chart B03



1 = Air-flow sensor
2 = CO potentiometer

TROUBLE-SHOOTING PROGRAM (13)

V

* Check overrun cutoff:

Connect the two-pole test lead 1 684 463 093 between an injection valve and its connector.
Connect motortester (special input) to test lead. Black clamp to vehicle ground.
Connect red clamp to one of the two connections of the test lead.

Caution: The free connection clamp of the test lead must not come into contact with ground.

Raise engine speed to 3000 min^{-1}. Injection signals visible (see top picture).
Suddenly release accelerator.

SET VALUE:
With falling engine speed, injection signals are suppressed and are reinstated above the idle speed.

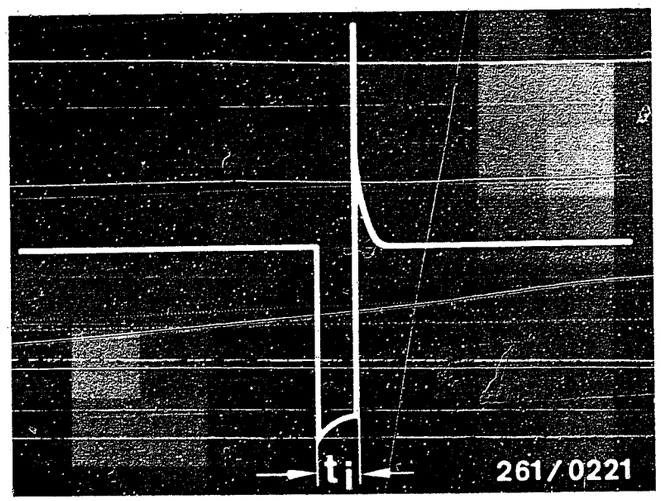
Set value O.K.?

N>

* Repeat test.

* Check idle contact in throttle-valve switch.

* Control unit defective.



Injection signal
t_i = Duration of injection

Y

V

Return to trouble-shooting chart B03

TECHNICAL BULLETIN

13...39

PARTS SET FOR SOLENOID-OPERATED INJECTION VALVES 0 280 150 2.. AND PRESSURE REGULATORS 0 280 160 2..

VDT-I-261/102 En
6.1983

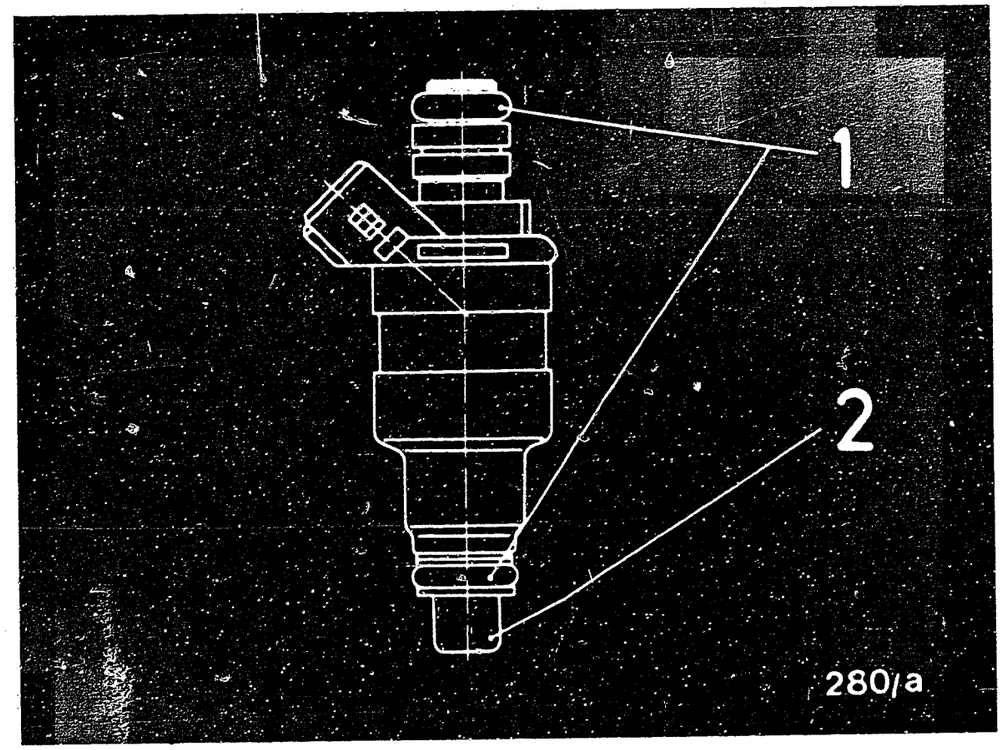
supersedes 8.82 edition

A common parts set is available for the Motronic solenoid-operated injection valves and pressure regulators with the new method of connection.

Since the above-mentioned parts are subjected to extreme temperature stress, they should be exchanged for new parts whenever servicing is carried out.

"Unmetered air" sucked in through injection-valve seals which are not tight is a frequent case for servicing.

The parts set has the part number 1 287 010 704 and is listed in the service-parts microcard under solenoid-operated injection valves (see EE 00 under 0 280..).



1 = O-ring 2 = Protection sleeve

Contents for 1 injection valve:
2 x O-ring
1 x Protection sleeve, yellow

Contents for pressure regulator:
1 x O-ring
1 x Supporting plate

Published by:

ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD 2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

28
VDT-I-280/111 En
11.1984

PLUG CONNECTORS FOR
JETRONIC COMPONENTS

Parts sets

supersedes Ed. 11.1982

Parts sets are available for the replacement of Jetronic plug connectors, comprising:

* Plug-connector housing
* Protective cap (rubber sleeve)
* Contact springs

These parts are listed on microcard EE...*

* See microcards EE00 and 0 280 ..

* Plug, black, 2-pole,
  parts set 1 287 013 002 cable connector
  in conjunction with socket, 2-pole.

* Socket, black, 2-pole,
  parts set 1 287 013 001 for e.g.

  Temperature sensor 0 280 130 0..
  Auxiliary-air device 0 280 140 ..
  Thermo-time switch 0 280 130 2..
  Start valve 0 280 170 ..
  Warm-up regulator 0 438 140 ..

* Socket, gray, 2-pole,
  parts set 1 287 013 003 for:

  Injection valve 0 280 156 ..

* Socket, black, 3-pole
  parts set 1 237 000 039 for:

  Throttle-valve switch 0 280 120 ..

* Socket, black, 5-pole,
  parts set 1 287 013 006 for:

  Air-flow sensor 0 280 20. .. (LE version)

* Socket, black, 6-pole,
  parts set 1 287 013 004 for

  Air-flow sensor 0 280 200 ..

* Socket, black, 7-pole,
  parts set 1 287 013 005 for:

  Air-flow sensor 0 280 20. ..
  Air-mass sensor 0 280 211 ..

* Wiring-harness plug connector, black, 25-pole,
  parts set 1 287 013 009 for:

  Control unit 0 280 0..

* Wiring-harness plug connector, black, 35-pole,
  parts set 1 287 013 008 for:

  Control unit 0 280 0..

The contact springs (minitimers) are also available individually under part number 1 284 477 026.

The plug-connector housings are available only in the stated colors.

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Division KH
Technical After-Sales Service (KH/VKD 2)
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